SCIENCE

NEW SERIES. VOL. VI. No. 155. FRIDAY, DECEMBER 17, 1897. SINGLE COPIES, 15 CTS. ANNUAL SUBSCRIPTION, $5.00

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*SIGNALLING THROUGH SPACE WITHOUT WIRES.**

SCIENCE has conferred one great benefit on mankind. It has supplied us with a new sense. We can now see the invisible, hear the inaudible and feel the intangible. We know that the universe is filled with a homogeneous continuous elastic medium which transmits heat, light, electricity and other forms of energy from one point of space to another without loss. The discovery of the real existence of this 'ether' is one of the great scientific events of the Victorian era. Its character and mechanism are not yet known by us. All attempts to 'invent' a perfect ether have proved beyond the mental powers of the highest intellects. We can only say with Lord Salisbury that the ether is the nominative case to the verb 'to undulate.' We must be content with a knowledge of the fact that it was created in the beginning for the transmission of energy in all its forms, that it transmits these energies in definite waves and with a known velocity, that it is perfect of its kind, but that it still remains as inscrutable as gravity or life itself.

Any disturbance of the ether must originate with some disturbance of matter. An explosion, cyclone or vibratory motion may occur in the photosphere of the sun. A disturbance or wave is impressed on the

* An address given before the Royal Institution by W. H. Preece, Esq., C.B., F.R.S., M.Inst.C.E.

ether. It is propagated in straight lines through space. It falls on Jupiter, Venus, the Earth and every other planet met with in its course, and any machine, human or mechanical, capable of responding to its undulations indicates its presence. Thus the eye supplies the sensation of light, the skin is sensitive to heat, the galvanometer indicates electricity, the magnetometer indicates disturbances in the earth's magnetic field. One of the greatest scientific achievements of our generation is the magnificent generalization of Clerk-Maxwell that all these disturbances are of precisely the same kind, and that they differ only in degree. Light is an electromagnetic phenomenon, and electricity in its progress through space follows the laws of optics. Hertz proved this experimentally, and few of us who heard it will forget the admirable lecture on 'The Work of Hertz' given in this hall by Professor Oliver Lodge three years ago.*

By the kindness of Professor Silvanus Thompson, I am able to illustrate wave transmission by a very beautiful apparatus devised by him. At one end we have the *transmitter* or oscillator, which is a heavy suspended mass to which a blow or impulse is given, and which, in consequence, vibrates a given number of times per minute. At the other end is the *receiver*, or resonator, timed to vibrate to the same period. Connecting the two together is a row of leaden balls suspended so that each ball gives a portion of its energy at each oscillation to the next in the series. Each ball vibrates at right angles to or athwart the line of propagation of the wave, and as they vibrate in different phases you will see that a wave is transmitted from the transmitter to the receiver. The receiver takes up these vibrations and responds in sympathy with the transmitter. Here we have a visible illustration of that which is absolutely invisible. The wave you see differs from a wave of light or of electricity only in its length or in its frequency. Electric waves vary from units per second in long submarine cables to millions per second when excited by Hertz's method. Light waves vary per second between 400 billions in the red to 800 billions in the violet, and electric waves differ from them in no other respect. They are reflected, refracted and polarized; they are subject to interference, and they move through the ether in straight lines with the same velocity, viz., 186,400 miles per second—a number easily recalled when we remember that it was in the year 1864 that Maxwell made his famous discovery of the identity of light and electric waves.

Electric waves, however, differ from light waves in this, that we have also to regard the direction at right angles to the line of propagation of the wave. The model gives an illustration of that which happens along a *line of electric force;* the other line of motion I speak of is a circle around the point of disturbance, and these lines are called *lines of magnetic force.** The animal eye is tuned to one series of waves; the 'electric eye,' as Lord Kelvin called Hertz's resonator, to another. If electric waves could be reduced in length to the forty-thousandth of an inch we should see them as colors.

One more definition, and our ground is cleared. When electricity is found stored up in a potential state in the molecules of a dielectric like air, glass or gutta-percha the molecules are strained; it is called a *charge*, and it establishes in its neighborhood *an electric field*. When it is active, or in its kinetic state in a circuit, it is called a *current*. It is found in both states, kinetic and potential, when a current is maintained in a conductor. The surrounding neighborhood is then found in a state of stress, forming what is called a *magnetic field*.

* This is published in an enlarged and useful form by *The Electrician* Printing and Publishing Company.—W. H. P.

* *Vide* Fig. 4.

In the first case the charges can be made to rise and fall, and to surge to and fro with rhythmic regularity, exciting *electric waves* along each line of electric force at very high frequencies, and in the second case the currents can rise or alternate in direction with the same regularity—but with very different frequencies—and originate *electro-magnetic waves* whose wave fronts are propagated in the same direction.

The first is the method of Hertz, which has recently been turned to practical account by Mr. Marconi, and the second is the method which I have been applying, and which for historical reasons I will describe to you first.

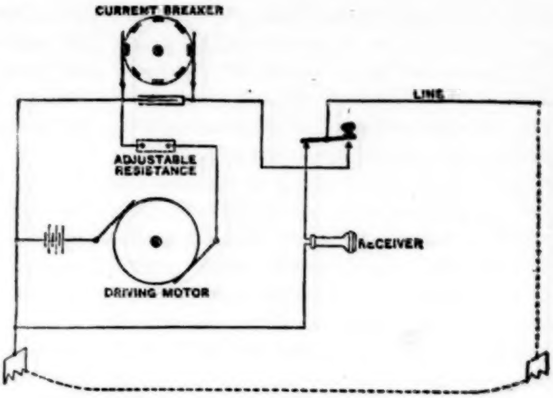

FIG. 1. Diagram of connections of Mr. Preece's system.

In 1884 messages sent through insulated wires buried in iron pipes in the streets of London were read upon telephone circuits erected on poles above the housetops, 80 feet away. Ordinary telegraph circuits were found in 1885 to produce disturbances 2,000 feet away. Distinct speech by telephone was carried on through one-quarter of a mile, a distance that was increased to 1¼ miles at a later date. Careful experiments were made in 1886 and 1887 to prove that these effects were due to pure electro-magnetic waves, and were entirely free from any earth conduction. In 1892 distinct messages were sent across a portion of the Bristol Channel between Penarth and Flat Holm, a distance of 3.3 miles.

Early in 1895 the cable between Oban and the Isle of Mull broke down, and as no ship was available for repairing and restoring communication, communication was established by utilizing parallel wires on each side of the Channel and transmitting signals across this space by these electro-magnetic waves.

The apparatus (Fig. 1) connected to each wire consists of:

(*a*) A rheotome or make and break wheel, causing about 260 undulations per second in the primary wire.

(*b*) An ordinary battery of about 100 Leclanché cells, of the so-called dry and portable form.

(*c*) A Morse telegraph key.

(*d*) A telephone to act as receiver.

(*e*) A switch to start and stop the rheotome.

Good signals depend more on the rapid rise and fall of the primary current than on the amount of energy thrown into vibration. Leclanché cells give as good signals at 3.3 miles distant as 2½ H.P. transformed into alternating currents by an alternator, owing to the smooth sinusoidal curves of the latter. 260 vibrations per second give a pleasant note to the ear, easily read when broken up by the key into dots and dashes.

In my electro-magnetic system two parallel circuits are established, one on each side of a channel or bank of a river, each circuit becoming successively the primary and secondary of an induction system, according to the direction in which the signals are being sent. Strong alternating or vibrating cur-

rents of electricity are transmitted in the first circuit so as to form signals, letters and words in Morse character. The effects of the rise and fall of those currents are transmitted as electro-magnetic waves through the intervening space, and if the secondary circuit is so situated as to be washed by these etheral waves, their energy is transformed into secondary currents in the second circuit, which can be made to affect a telephone and thus to reproduce the signals. Of course, their intensity is much reduced but still their presence has been detected, though five miles of clear space have separated the two circuits.

Such efforts have been known scientifically in the laboratory since the days of Faraday and of Henry, but it is only within the last few years that I have been able to utilize them practically through considerable distances. This has been rendered possible through the introduction of the telephone.

Last year (August, 1896) an effort was made to establish communication with the North Sandhead (Goodwin) lightship. The apparatus used was designed and manufactured by Messrs. Evershed and Vignoles, and a most ingenious relay to establish a call was invented by Mr. Evershed. One extremity of the cable was coiled in a ring on the bottom of the sea, embracing the whole area over which the lightship swept while swinging to the tide, and the other end was connected with the shore. The ship was surrounded above the water line with another coil. The two coils were separated by a mean distance of about 200 fathoms, but communication was found to be impracticable. The screening effect of the sea water and the effect of the iron hull of the ship absorbed practically all the energy of the currents in the coiled cable, and the effects on board, though perceptible, were very trifling—too minute for signalling. Previous experiments had failed to show the extremely rapid rate at which energy is absorbed with the depth or thickness of sea water. The energy is absorbed in forming eddy currents. There is no difficulty whatever in signalling through 15 fathoms. Speech by telephone has been maintained through 6 fathoms. Although this experiment has failed through water, it is thoroughly practicable through air to considerable distances where it is possible to erect wires of similar length to the distance to be crossed on each side of the channel. It is not always possible, however, to do this, nor to get the requisite height to secure the best effect. It is impossible on a lightship and on rock lighthouses. There are many small islands—Sark, for example—where it cannot be done.

In July last Mr. Marconi brought to England a new plan. My plan is based entirely on utilizing electro-magnetic waves of very low frequency. It depends essentially on the rise and fall of *currents* in the primary wire. Mr. Marconi utilizes electric or Hertzian waves of very high frequency, and they depend upon the rise and fall of electric force in a sphere or spheres. He has invented a new relay which, for sensitiveness and delicacy, exceeds all known electrical apparatus.

The peculiarity of Mr. Marconi's system is that, apart from the ordinary connecting wires of the apparatus, conductors of very moderate length only are needed, and even these can be dispensed with if reflectors are used.

The Transmitter.—His transmitter is Professor Righi's form of Hertz's radiator (Fig. 2).

Two spheres of *solid* brass, 4 inches in diameter (A and B), are fixed in an oil-tight case D of insulating material, so that a hemisphere of each is exposed, the other hemisphere being immersed in a bath of vaseline oil. The use of oil has several

advantages. It maintains the surfaces of the spheres electrically clean, avoiding the frequent polishing required by Hertz's exposed balls. It impresses on the waves excited by these spheres a uniform and con-

FIG. 2. Diagram of the Marconi Apparatus.

stant form. It tends to reduce the wave lengths; Righi's waves are measured in centimetres, while Hertz's were measured in metres. For these reasons the distance at which effects are produced is increased. Mr. Marconi uses generally waves of about 120 centimetres long. Two small spheres, *a* and *b*, are fixed close to the large spheres, and connected each to one end of the secondary circuit of the 'induction coil' C, the primary circuit of which is excited by a battery E, thrown in and out of circuit by the Morse key K. Now, whenever the key K is depressed sparks pass between 1, 2 and 3, and since the system A B contains a capacity and electric inertia, oscillations are set up in it of extreme rapidity. The line of propagation is D *d*, and the frequency of oscillation is probably about 250 millions per second.

The distance at which effects are produced with such rapid oscillations depends chiefly on the energy in the discharge that passes. A 6-inch spark coil has sufficed through 1, 2, 3, up to 4 miles, but for greater distances we have used a more powerful coil—one emitting sparks 20 inches long. It may also be pointed out that this distance increases with the diameter of the spheres A and B, and it is nearly doubled by making the spheres solid instead of hollow.

The Receiver.—Marconi's relay (Fig. 2) consists of a small glass tube four centimeters long, into which two silver pole-pieces are tightly fitted, separated from each other by about half a millimeter—a thin space which is filled up by a mixture of fine nickel and silver filings, mixed with a trace of mercury. The tube is exhausted to a vacuum of 4 mm., and sealed. It forms part of a circuit containing a local cell and a sensitive telegraph relay. In its normal condition the metallic powder is virtually an insulator. The particles lie higgledy-piggledy, anyhow, in disorder. They lightly touch each other in an irregular method, but when electric waves fall upon them they are 'polarized,' order is installed. They are marshalled in serried ranks; they are subject to pressure—in fact, as Professor Oliver Lodge expresses it, they 'cohere'—electrical contact ensues and a current passes. The resistance of such a space falls from infinity to about five ohms. The electric resistance of Marconi's relay—that is, the resistance of the thin disc of loose powder—is practically infinite when it is in its normal or disordered condition. It is, then, in fact, an insulator. This resistance drops sometimes to five ohms, when the absorption of the electric waves by it is intense. It, therefore, becomes a conductor. It may be, as suggested by

Professor Lodge, that we have in the measurement of the variable resistance of this instrument a means of determining the intensity of the energy falling upon it. This variation is being investigated both as regards the magnitude of the energy and the frequency of the incident waves. Now such electrical effects are well known. In 1866 Mr. S. A. Varley introduced a lightning protector constructed like the above tube, but made of boxwood and containing powdered carbon. It was fixed as a shunt to the instrument to be protected. It acted well, but it was subject to this coherence, which rendered the cure more troublesome than the disease, and its use had to be abandoned. The same action is very common in granulated carbon microphones like Hunting's, and shaking has to be resorted to, to decohere the carbon particles to their normal state. M. E. Branly (1890) showed the effect with copper, aluminium and iron filings. Professor Oliver Lodge, who has done more than any one else in England to illustrate and popularize the work of Hertz and his followers, has given the name 'coherer' to this form of apparatus. Marconi 'decoheres' by making the local current very rapidly vibrate a small hammer head against the glass tube, which it does effectually, and in doing so makes such a sound that reading Morse characters is easy. The same current that decoheres can also record Morse signals on paper by ink. The exhausted tube has two wings which, by their size, tune the receiver to the transmitter by varying the capacity of the apparatus.* Choking coils prevent the energy escaping. The analogy to Professor Silvanus Thompson's wave apparatus is evident. Oscillations set up in the transmitter fall upon the receiver tuned in sympathy with it, coherence follows, currents are excited and signals made.

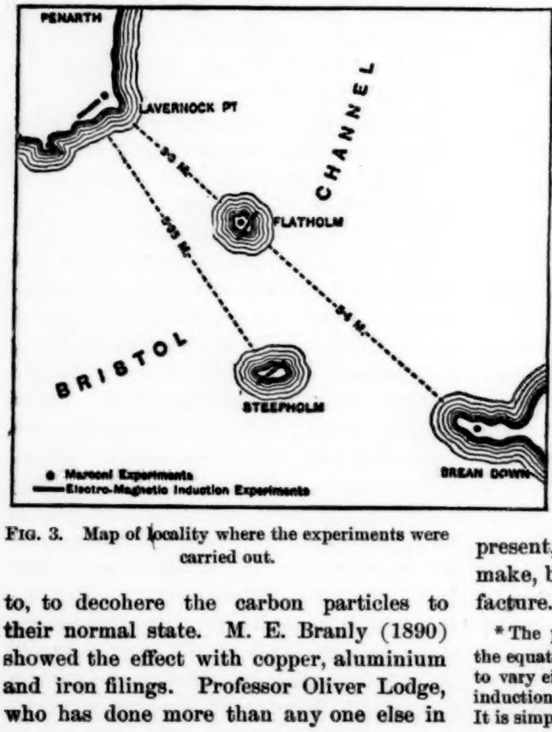

FIG. 3. Map of locality where the experiments were carried out.

In open clear spaces within sight of each other nothing more is wanted, but when obstacles intervene and great distances are in question height is needed; tall masts, kites and balloons have been used. Excellent signals have been transmitted between Penarth and Brean Down, near Weston-super-Mare, across the Bristol Channel, a distance of nearly nine miles (Fig. 3). [The system was here shown in operation.]

Mirrors also assist and intensify the effects. They were used in the earlier experiments, but they have been laid aside for the present, for they are not only expensive to make, but they occupy much time in manufacture.

* The period of vibration of a circuit is given by the equation $T = 2\pi \sqrt{KL}$, so that we have simply to vary either the capacity K or the so-called 'self-induction' L to tune the receiver to any frequency. It is simpler to vary K.

It is curious that hills and apparent obstructions fail to obstruct. The reason is probably the fact that the lines of force escape these hills. When the ether is entangled in matter of different degrees of inductivity the lines are curved, as in fact they are in light. Fig 4 shows how a hill is vir-

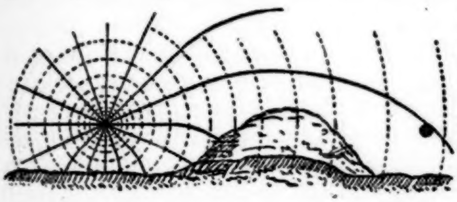

FIG. 4. Diagram illustrating the way in which hills are bridged by the electric waves.

tually bridged over by these lines, and consequently some electric waves fall on the relay. Weather seems to have no influence —rain, fogs, snow and wind avail nothing.

The wings in Fig. 2 may be removed. One pole can be connected with earth, and the other extended up to the top of the mast, or fastened to a balloon by means of a wire. The wire and balloon or kite covered with tin foil becomes the wing. In

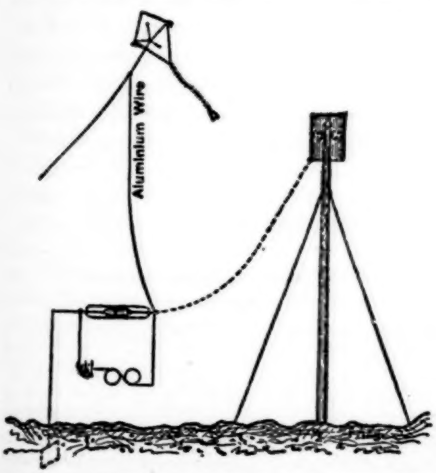

FIG. 5. Diagram of Marconi connections when using pole or kite.

this case one pole of the transmitter must also be connected with the earth. This is shown by Fig. 5.

There are some apparent anomalies that have developed themselves during the experiments. Mr. Marconi finds that his relay acts even when it is placed in a perfectly closed metallic box. This is the fact that has given rise to the rumor that he can blow up an iron-clad ship. This might be true if he could plant his properly tuned receiver in the magazine of an enemy's ship. Many other funny things could be done if this were possible. I remember in my childhood that Captain Warner blew up a ship at a great distance off Brighton. How this was done was never known, for his secret died shortly afterwards with him. It certainly was not by means of Marconi's relay.

The distance to which signals have been sent is remarkable. On Salisbury Plain Mr. Marconi covered a distance of four miles. In the Bristol Channel this has been extended to over eight miles, and we have by no means reached the limit. It is interesting to read the surmises of others. Half a mile was the wildest dream.*

It is easy to transmit many messages in any direction at the same time. It is only necessary to tune the transmitters and receivers to the same frequency or 'note.' I could show this here, but we are bothered by reflection from the walls. This does not happen in open space. Tuning is very easy. It is simply necessary to vary the capacity of the receiver, and this is done by increas-

* "Unfortunately at present we cannot detect the electro-magnetic waves more than 100 feet from their source." Trowbridge, 1897, *What is Electricity*, p. 256.

"I mention 40 yards because that was one of the first out-of-door experiments, but I should think that something more like half a mile was nearer the limit of sensibility. However, this is a rash statement not at present verified." Oliver Lodge, 1894, *The Work of Hertz*, p. 18.

ing the length of the wings W in Fig. 2. The proper length is found experimentally close to the transmitter. It is practically impossible to do so far away.

It has been said that Mr. Marconi has done nothing new. He has not discovered any new rays; his transmitter is comparatively old; his receiver is based on Branly's coherer. Columbus did not invent the egg, but he showed how to make it stand on its end, and Marconi has produced from known means a new electric eye more delicate than any known electrical instrument, and a new system of telegraphy that will reach places hitherto inaccessible. There are a great many practical points connected with this system that require to be threshed out in a practical manner before it can be placed on the market, but enough has been done to prove its value, and to show that for shipping and lighthouse purposes it will be a great and valuable acquisition.

CHARACTERS, CONGENITAL AND ACQUIRED.

THE characters of a living organism, plant or animal, are usually grouped by biologists under two heads, the congenital, or inborn, and the acquired. But hitherto no systematic attempt has been made to give precision to these terms—to define precisely what we mean by them, and in the case of any particular organism to ascertain exactly which of its characters are inborn and which acquired. I know nothing in the whole range of science which promises to the thinker more immediate and solid results than this strangely neglected field of investigation. For example, had it received the attention it deserved, it is probable that the great controversy as to the transmissibility of acquired traits between the Neo-Lamarckian and Darwinian schools would long ago have ceased, since only after it has been definitely determined whether this or that trait is inborn or acquired can the fact of its transmissibility or non-transmissibility profitably be used as an argument for or against the Lamarckian doctrine. This precisely the disputants have not done—an assertion I shall justify presently. To deal with my subject adequately one should have the powers of a Darwin or a Herbert Spencer; if, however, I can contrive to direct attention to it I shall be well content.

An inborn variation may be defined as one which arises in an organism owing to changes previously produced by the action of the environment in the germ cell (or pair of germ cells) whence it sprang. As inborn variations are admittedly transmissible, all inborn characters must have arisen thus in the ancestry* and, deductively, it must follow, as, indeed, may easily be proved inductively,† that changes in a germ cell tend to be reproduced in its descendant germ cells, for which reason the organisms that arise from them tend also to reproduce the inborn variations of the parent organism.

An acquired character may be defined as one which arises in the organism owing to changes produced by the action of the environment, not on the germ cell, but on the somatic cells derived from it. If acquired modifications are transmissible, then changes in the somatic cells must tend so to modify the germ cells associated with them that, as a consequence, the organisms they proliferate into tend to reproduce, as inborn characters, the *particular* variations which were acquired by the parent organism.

* That is, if we accept the Neo-Darwinian doctrine.

† All unicellular organisms are germ cells; that is, they are all capable of continuing the species. When modified by the action of the environment they tend to transmit their modifications to descendant organisms, as has been abundantly proved by bacteriologists. A striking example is afforded by the organism which produces small-pox. If transferred to the cow it becomes so modified in the new environment that it ever afterwards causes in man, not small-pox, but cow-pox.

I dare say that the above definitions will be objected to by some of my readers, but I am in hopes that, on consideration of what follows, the majority will assent to them as indicating pretty correctly what we really mean by the terms 'inborn' and 'acquired.' I do not here propose to discuss the question as to whether acquired modifications are transmissible; I have done it at length elsewhere, and my present object is rather to differentiate accurately between the acquired and the congenital, and to ascertain the parts played by them respectively in the organic world. I may, in passing, however, notice one or two points which have been frequent sources of confusion and the consideration of which may help to bring the meaning I intend my definitions to bear clearly before the mind.

It has often been maintained by Neo-Lamarckians that important modifications in the soma (*e. g.*, the effects of disease) *must* affect the associated germ cells, and that therefore acquired modifications *must*, to some extent, be transmissible.* They miss the point at issue. It is not denied that changes in the germ's environment (*i. e.*, in the body of the parent) may result in modifications in the organism into which the germ subsequently proliferates, but it is strenuously denied that acquired modifications in the parent tend specially so to modify the germ as to cause the organism into which it subsequently proliferates to reproduce congenitally the particular modification which the parent acquired. Again, supposing some cause (*e. g.*, disease) produced a modification (*e. g.*, cavities in the lungs) in the soma and that subsequently, in the absence of the cause, the offspring developed the modification; even this would not constitute an absolute proof of the Lamarckian doctrine, though it would raise a presumption in favor of it. For it must be remembered that it is not asserted that a force acting on an organism cannot produce such a change in the germ as will cause the organism into which it develops to exhibit a variation similar to the modification produced by the force in the parent, but that it is asserted that this coincidence, this mere coincidence, must, from the nature of the case, be extremely rare, so very rare that, as factors in evolution, such apparent, but only apparent, transmission of acquired traits may practically be ignored. Only after it had been shown that clear and indubitable cases of reproduction by the offspring of the parents' modification were not uncommon in nature could the truth of the Lamarckian doctrine be accepted as proven.

Watching the multiplication of an infusorian (*Stylonychia Pustulata*), Maupas observed that, after two of these had conjugated, the resulting fertilized cell divided and redivided many times without conjugation again occurring, but that if, after a certain pretty definite number of cell-divisions, conjugation did not again occur, the race ultimately died out. He found, moreover, that the descendants of a conjugated pair did not conjugate among themselves, but only with the descendants of another conjugated pair. All this is the rule among higher plants and animals. The ovum and the sperm are unicellular organisms. After conjugation they divide and redivide many times without conjugation again occurring among the descendant cells. But these, like the infusorians, if they do not conjugate, ultimately die out. Most of them (*i. e.*, the somatic cells) are incapable of conjugation, while such of them as are capable of conjugation (*i. e.*, the germ cells) conjugate only with cells

* "The germ is a unicellular organism and therefore it should be modifiable in accordance with its environment. Such environment would be different in the body of a sedentary clerk and a hard-working agricultural laborer, and on this hypothesis the offspring in these cases would be different." (S. S. Buckman, *Natural Science*, March, 1897, p. 189.)

from another body (*i. e.*, cell-family). There are, as is well known, exceptions to the above; unending reproduction may occur without conjugation, as among such plants as are propagated by slips or suckers, and self-fertilization also occurs, but the general rule is as I have stated. A multicellular plant or animal in the successive stages of its development is therefore the homologue, not of the remote ancestral unicellular organism, but of all those successive generations of unicellular organisms which intervene between one act of conjugation and the next.

Unlike the cell descendants of a conjugated unicellular organism, the cell-descendants of a conjugated germ differ from it, and from one another, in that they undergo differentiation along certain definite lines (into nerve, muscle, bone, etc.), the germ cells being so specialized that the cell-communities which spring from them are very like the cell-community of which they were cell-members, for which reason a man, for instance, is like his parent. Moreover, the cell-descendants of the conjugated germ differ from the cell-descendants of the conjugated unicellular organism in that they remain adherent, and in that, in different lines of descent, they multiply at different though definite rates. Did the cell-descendants of the germ all multiply at an equal rate, a solid spherical mass of cells would, of course, result; whereas, owing to differences in their rates of multiplication, the shape of multicellular plants and animals are irregular (*i. e.*, not spherical). But, though these rates of multiplication in different lines of descent are pretty definite in every species of plant and animal, they differ widely in different species, whence arise differences in shape betwixt one species and another. An ox, for instance, differs in shape from a man because in it the cells in different lines of descent do not multiply at the same rate as in the man.

We cannot doubt that, when first multicellular organisms were evolved from unicellular, all the cells constituting the mass were morphologically and physiologically similar, and that, therefore, like the ancestral unicellular organism, every cell was capable of performing all the functions of life—food-getting, locomotion, reproduction of the race, etc. Later, as a result of natural selection, differentiation appeared among the adherent cells of the community, some taking on one function and some another, till at length a high degree of differentiation resulted, and the reproduction of the race was delegated to the germ cells.

As I have already indicated, among the unicellular organisms every cell is a germ cell, and as such is capable of continuing the race. Among low multicellular organisms this power persists in many cells, and the environment decides whether it shall be exercised or not; thus, if almost any fragment of a sponge be bedded out it will proliferate into a complete individual. It persists longer in plants than in animals; thus from a fragment of begonia leaf may arise an entire individual capable of continuing the race; the cells are being turned from their original destiny by a change in the environment. But among the higher plants this power of reproducing the entire individual by means of cells other than germ cells, or what may normally proliferate into germ cells, is very exceptional. All that commonly persists is the power of reproducing from such fragments of the complete organism as contain cells, which might normally proliferate into germ cells, the parts wanting to render the fragment a complete organism. Thus a geranium slip (for instance) contains cells which normally (*i. e.*, when the branch remains part of the plant) proliferate into germ cells; if this branch be bedded out as a slip it produces the roots which are needed to convert it into a complete organism of its

species. Here germ cells are not produced from cells not destined to that purpose as in the begonia leaf, but lost parts are reproduced by what may be termed (and in fact is) an exaggerated process of healing. In other plants the power of reproducing lost parts is present in a much smaller scale, and only comparatively trifling injuries are healed; *i. e.*, a small fragment cannot reproduce the whole, though the whole can reproduce lost fragments. Among animals, owing to the greater specialization of the cells and the more complex condition under which they live, this power of reproducing lost parts is present in general to a much less extent than among plants. Low in the scale, as we see, a fragment of sponge, for instance, can reproduce the whole. Higher in the scale, a starfish can reproduce a ray, a lobster a claw, a lizard its tail, and so forth, but none of these parts can reproduce the whole; that is done solely by germ cells. Higher yet, as among birds and mammals, the power of reproducing lost parts is comparatively very trifling; important and complex parts cannot be restored. Wounds and mutilations are healed, but, if serious, very imperfectly, for only scar tissue replaces the normal tissues which were lost.

We see, then, that the reproduction of lost parts, whether it be on a very great and perfect scale, as when a fragment reproduces a whole as in a sponge, or whether it be on a very small and imperfect scale, as when a wound is healed in one of the higher animals, is a process of the same order. Now, we speak of a scar in man, for example, as an acquired character; but who would dream of speaking of all that which is reproduced by the fragment of a sponge or a begonia leaf as a character acquired by the fragment. Moreover, when one of the higher animals is mutilated, as when a dog loses his tail, we lump together both the mutilation and the tissue with which the lost part is replaced (*i. e.*, the scar) as a single acquired character. But, even if we should agree for convenience to regard the scar as an acquired character, surely the mutilation ought not to be so designated, but should rather be termed (as I venture to suggest) *an enforced* character. We see, moreover, that the power of reproducing lost parts to a greater or less extent persists throughout organic nature, but that this power is vastly greater low in the scale than higher. In other words, if we agree to regard such reproductions as acquired, observation proves that the power of acquiring them is very much greater low in the scale (*e. g.*, sponge) than it is higher (*e. g.*, man).

On the other hand, there is another class of acquired characters—*perhaps the only class to which the term should properly be applied*—the power of acquiring which is greatest among the highest animals, and apparently is little or not at all present among the lower animals, nor in the whole of the plant world. I speak of such characters as arise as a result of exercise and use, as, for instance, the increased muscular power of an athlete. In the plant world no characters can, of course, be acquired as a response to the stimulation of exercise and use. Plants, therefore, of necessity, attain their full development in the absence of all other stimulation than such as is supplied by sufficient food and warmth. Of such plant-like animals as sponges the same also, of necessity, is true. It is true, with possible exceptions, even of such active animals as insects. Thus a pupa may develop into a perfect insect while lying quiescent. The lower vertebrates, such as fish and reptiles, have also little or no power of developing in response to the stimulation of use and exercise; apparently they are able to grow into normal, adult animals in its absence; thus if a tadpole finds its way through a crevice into a small cavity, and is able to obtain sufficient food, it develops

into a normal frog, though it leads a purely vegetative life. Higher yet in the scale among birds and mammals, and most of all among the highest mammals, the animal attains its full development, as regards many structures, only in response to the stimulation of exercise and use; thus, for instance, if the limb of an infant be locked by paralysis or by a joint disease so that it cannot be used it does not develop into an adult limb. Now, if a 'normal' man takes a more than ordinary amount of exercise he gets a more than ordinary development of various structures, as happens in the case of the blacksmith's arm. This extra development is regarded by biologists as 'abnormal' and is rightly termed 'acquired.' But, as we see, the 'normal' degree of development is attained only as a response to exercise (*i. e.*, stimulation), similar in kind though less in amount. *Therefore, it is clear that the full development of the normal adult arm, as well as many other important structures, is acquired*, differing in this from eyes, ears, teeth, nails, etc., which are wholly inborn, and do not owe their development in the least to use and exercise. In fact, on consideration, I think it will be found that adult man differs physically from the infant almost wholly in characters which are acquired, not in those which are inborn. In teeth, hair, skull-bones, genital organs, and in some other respects, he differs from the infant as regards inborn characters; but as regards almost all the structures of the trunk and limbs, and most of those of the head, the difference is in characters which have been acquired by the adult as a response to the stimulation of exercise and use. Thus the limbs develop wholly in response to use, the heart and arteries develop within certain limits in proportion to the strain put on them, as also do the lungs and their accessory muscles, as well as the bony attachments of the latter. The muscles, arteries, nerves, etc., of the head and neck also develop in response to the same stimulation. Moreover, the normal standard of development is maintained only as a response to this stimulation (*i. e.*, use, exercise), for example, when not used, the muscles with their coördinated structures atrophy and tend to disappear, as in the case of a paralyzed limb. It may be added that it is probable that even the infantile standard of development is, to some extent, acquired under the stimulus of fœtal movements in utero.

In upholding the doctrine of the transmissibility of acquired modifications much stress has been laid by Mr. Herbert Spencer and others on the exquisite coördination of the multitudinous parts of the high animal organism. They maintain that this coördination affords decisive proof of the Lamarckian theory, the line of argument being as follows: It is not probable that all the many structures of a high animal can ever have varied favorably together (as compared to the parent) in any individual animal. It is unbelievable that they can all have varied favorably generation after generation in a line of individuals. A chain is only as strong as its weakest link. A favorable variation, say a larger horn in the elk, if unaccompanied by corresponding variation in all the thousand parts (in head, neck, trunk, limbs) coördinated with it, would be useless, and even burdensome. In other words, if a single structure (muscle, bone, ligament, etc.) of all those associated with it failed to bear the strain of the larger horn, this variation would not favor survival, but, on the contrary, be a cause of elimination. Therefore, say these thinkers, the evolution of high multicellular animals cannot be attributed to the accumulation, during generations, of inborn variations alone, but must in part be attributed to the accumulation, during generations, of the effects of use and disuse, *i. e.*,

to the accumulation of acquired variations.

But variations acquired as a result of use and disuse are plainly never transmitted. Thus an infant's limb never attains to the adult standard except in response to the same stimulation (exercise) as that which developed the parent's limb. The same is true of all the other structures which in the parent underwent development as a result of use, or subsequent retrogression in the absence of it. These, like the limbs, do not develop or retrogress in the infant except as a result of similar causes. Plainly, then, what is transmitted to the infant is not the modification, but only *the power of acquiring it under similar circumstances*—a power which has undergone such an evolution in high animal organisms that, as I say, in man, for instance, almost all the development changes which occur between infancy and manhood are attributable to it. It follows, therefore, that the exquisite coördination of all the parts of a high animal is not due to the inherited effects of use and disuse, but to this great power of acquiring modifications along certain definite lines; so that if an animal varies in such a way as to have one of its structures (*e. g.*, horn, a structure which is wholly inborn) larger than in the parent, then all the other structures associated with it, owing to the increased strain (*i. e.*, the increased stimulation) put on them, undergo a corresponding modification, and thus preserve the harmony of all the parts of the whole. So also if the horn (for instance) be smaller than in the parent, the lesser strain placed by it on associated structures causes these also to develop less than in the parent, whereby again the harmony of the whole is preserved.

I have dwelt at greater length on this neglected subject of acquired characters (properly so-called) elsewhere,* but I think I have said enough even here to demonstrate its immense importance. The power of acquiring fit modifications in response to appropriate stimulation is that which especially differentiates high animal organisms from low animal organisms.* Without this power and the plasticity which results from it the multitudinous parts of high animals could not well be coordinated, and, therefore, without it their evolution could scarcely have been possible. Indeed, it is not too much to say, so vitally important is this power to the higher animals, that, as regards them, the chief aim (if I may use the expression) of natural selection has been to evolve it. But, since this power of developing in response to the stimulation of use operates mainly along certain definite lines, which are not quite the same in every species, the different species differ as regards size and shape, not only in characters which are inborn, but also in those which are acquired. Thus an ox differs in size and shape from a man not alone in inborn characters, but also in characters which are acquired as a result of exercise and use. The structures of both the ox and man develop in response to appropriate stimulation, but not quite in the same direction, nor in the same proportion, nor to the same degree; hence, to some extent the differences in size and shape betwixt the two animals. Consider, for instance, the hind limbs of the ox and man: in both these grow greatly as a response to the stimulation of exercise, but the lines of growth being somewhat different the limbs do not approximate in shape and size. Presently, when we consider mind, we shall realize even more strikingly the importance of our subject, and perceive how deeply it concerns many fields of thought and investigation which have greatly interested mankind in all ages; but I have still something more to say as regards

* Vide *The Present Evolution of Man*, pp. 108–21.

* The truth of this, as we shall see, is made particularly manifest by the study of mind.

physical characters, though it is not possible in the space allotted me to do full justice to the theme.

G. ARCHDALL REID.

SOUTHSEA, ENGLAND.

THE DESIRABILITY AND THE FEASIBILITY OF THE ACQUISITION OF SOME REAL AND ACCURATE KNOWLEDGE OF THE BRAIN BY PRE-COLLEGIATE SCHOLARS.*

NEVER before has the need of information as to the structure and function of the nervous system been so keenly felt by experts in various branches of knowledge and by practitioners of various specialties.

Never before, likewise, has there been so general and so earnest a desire for such information among the laity. For the first time has it been claimed by a prominent educator that neurology is a prime constituent of a liberal education. Among the branches of knowledge essential to a liberally educated man President Gilman names (*Educational Review*, III., 105–119, February, 1892), "first, the knowledge of his own physical nature, especially of his thinking apparatus, of the brain and the nervous system, by which his intellectual life is carried forward."

Under prevailing conditions, however, any approximation to a real and accurate knowledge of the brain is gained by but few, and at a late educational stage. Hence the public are ignorant or misinformed,* and the time that specialists might devote to research and advanced instruction is consumed in acquiring and im-

* This article is based upon a paper presented at the meeting of the American Society of Naturalists in Boston, December 29, 1896; it is an extension of the views expressed by that Society in 1891, 1892 and 1893 regarding a science requirement for admission to college and the introduction of natural history studies into the lowest grades of schools. It also embodies the substance of published or unpublished remarks upon the subject made by the writer on the following occasions:

1889.—In the article 'Anatomical Terminology,' Reference Handbook of the Medical Sciences (VIII., p. 532, § 82), occurs the following passage: "Aside from prejudice and lack of practical direction as to removing, preserving and examining the organ, there is but one valid reason why every child of ten years should not have an accurate and somewhat extended personal acquaintance with the gross anatomy of the mammalian brain; that obstacle is the enormous and unmanageable accumulation of objectionable names under which the parts are literally buried."

The foregoing paragraph is reproduced in a footnote upon p. 335 of my paper, 'Neural Terms, International and National,' *Jour. Comp. Neurology*, VI., 216–352, December, 1896 (issued February, 1897).

1896, a.—An address before the Home Congress, in Boston, October 13, 1896, was entitled 'Brains for the young: the desirability and the feasibility of the acquisition of some real knowledge of the brain by precollegiate scholars.' Through misapprehension a report of the address was printed in the *Arena* for March, 1897, pp. 575–583. Although unauthorized and containing some errors, it fairly represents what was said.

1896, b.—At the meeting of the New York State Science Teachers' Association in Buffalo, December 31, 1896, in the discussion on Biology in the Schools, the main points of the article above named were briefly stated; they were correctly reported in SCIENCE, April 2, 1897, p. 537.

1897.—A paper on 'The practical study of the brain in a primary school' was read before the University Convocation, June 29, 1897.

*Among the anxious parents and teachers to whom they are addressed how many are able to profit by the information contained in, for example, Donaldson's 'The growth of the brain' and Halleck's 'The education of the central nervous system?' How many persons recognize as erroneous the statements so frequently made as to the supreme absolute or relative size of the human brain? May not high school pupils describe the rivers of Africa and even the 'canals' of Mars and yet be so little familiar with the topography of the cerebrum as to accept without question the alleged representations thereof in most text-books, misrepresentations that might serve equally well for a heap of sausages? A large part of the community is at the mercy of charlatans, and squanders time and money upon that peculiarly American humbug, phrenology as practised. In a recent issue of a popular magazine, whose editor is sincerely interested in education, is an article containing not merely the phrenologic misstatements and vapidities, but a diagram of the 'convolutions of the brain' which has no basis of fact.

parting the neurologic alphabet. Indeed, so numerous are the parts of the central nervous system,* so heterogeneous and unfamiliar are their appellations,† so complex are their connections, so subtle and interdependent are their operations, so multifarious and difficult are histologic and physiologic manipulations, so diverse are the interpretations of nervous phenomena, and so voluminous is the literature of neurology,‡ that by the time existing knowledge is fairly mastered the would-be investigator has too often passed the period of greatest energy, enthusiasm and opportunity.

Were the practical study of the brain commenced in the primary schools two results might be anticipated, viz.:

First, the more general and thorough comprehension of the references to the structure, functions, disorders and injuries of the brain that occur with increasing frequency in lay as well as professional publications.

Secondly, among the many thus early and systematically trained in the fundamentals of neurologic fact, theory, method and literature, such as were fitted by nature and nurture to increase knowledge would be several years in advance of investigators as now prepared.

My general proposition is that *a certain amount of study of the vertebrate brain constitutes an indispensable element of every course at every educational stage; that this study be objective; that dissections and drawings§ be imperatively required; and that the forms and methods employed, and the ideas and generalizations inculcated and elucidated, be adapted to the average mental condition at the several epochs.*

The following remarks and quotations may serve to introduce an outline of neurologic study and to avert some possible objections.

The human brain is commonly the ultimate object of inquiry, but it is so difficult to obtain, preserve, manipulate and comprehend that animal brains are more conveniently employed at first. *Fiat experimentum in corpore vili.*

Descriptions, pictures and models may serve to convey additional information to such as are already fairly well informed; but there should first be laid a concrete foundation composed of direct personal impressions of the object, manual as well as visual.

Other things being equal, the acquisition of advanced knowledge is rapid and perfect in direct ratio with the earliness and thoroughness of appropriate preliminary training.*

The higher a material superstructure, the deeper are laid its foundations. If, therefore, as stated by Minot, the human brain is the most complex organ known, and if the human intellect is destined to be long baffled by the mysteries of its own agent, so much the rather should the fundamental facts and ideas of neurology be firmly fixed in the vacant and receptive depths of the youthful mind.

Because the elaborations of a science tax the mental powers of the philosopher is no reason for postponing its rudiments un-

*Including the meninges and blood-vessels, there are between five and six hundred; see the lists compiled by the committee of the Anatomische Gesellschaft and by the writer; 'Neural Terms,' etc., 1896.

†In 1888 the total in all languages was 10,500; see 'Neural Terms,' etc., pp. 230-231.

‡The card-catalogue prepared in the neurologic laboratory of Cornell University refers mainly to vertebrates and includes between five and six thousand titles.

§In a recent discussion of 'Physiology in the Schools' (University Convocation Report, 1896, p. 74) I have declared my belief that "children should be taught to draw before they write."

*In a very different connection it has been declared by Professor W. W. Goodwin (*The Nation*, October 24, 1895, 'School English') that "whatever study is to be pursued with effect must have its foundations laid before the age of fifteen."

til old age. At one extreme of astronomy are problems of the universe; but at the other is the recognition of the more conspicuous stars.

Mere memorizing becomes more and more irksome and difficult with age, while the youthful mind has been well characterized *potamus*, *rhinoceros*, *hypotheneuse*, *appendix* and *chrysanthemum*.

Other things being equal, the readiness with which a new term is assimilated is in direct ratio with the completeness of the impression associated therewith. The pupils who succeed in remembering the names

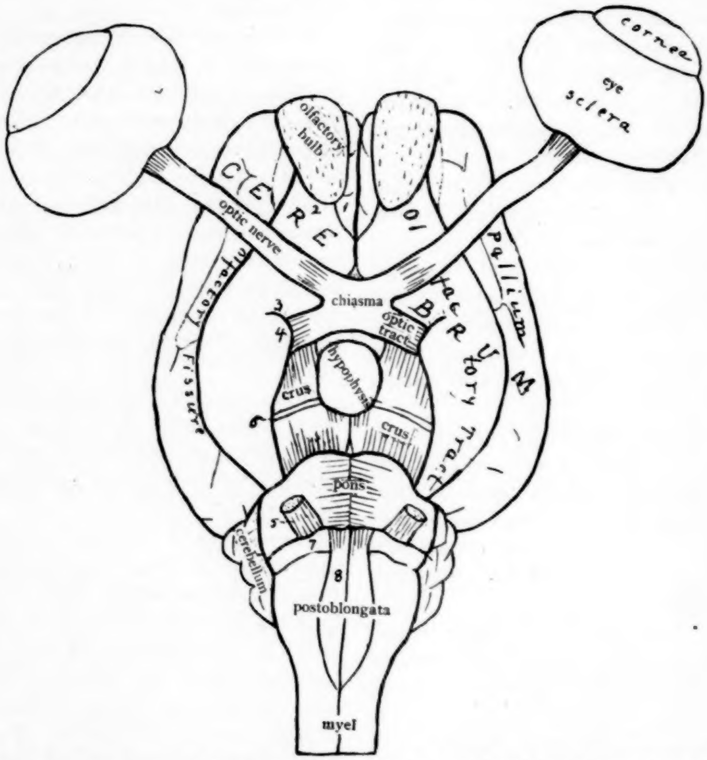

FIG. 1. Base or ventral aspect of the sheep's brain with the eyes attached; slightly enlarged. From the writer's 'Physiology Practicums,' second edition, 1895.

as 'wax to receive and adamant to retain.' Hence the desirability of the early acquisition of the main facts and terms of neurology.

Children have no prejudices against words of classical origin. *Hippocampus*, *rhinencephalon*, *hypophysis*, *fornix* and *callosum* would be accepted quite as readily as *hippo*- of mountains (*e. g.*, Himalayas) which few can anticipate visiting, and of ancient warriors (*e. g.*, Agamemnon) whose features are unknown to them, will promptly accept and firmly retain the designations of parts of their own bodies, especially when those same parts, obtained from animals, are not merely seen by them, but handled and dissected.

Children are spontaneously interested in natural objects. Like the terror of dogs, the squeamishness that would induce reluctance to handle a 'specimen' is commonly an artificial condition induced by the ignorant or thoughtless interference of parents or teachers. Left to itself the healthy child sucks in knowledge through its finger-tips.

Paradoxical as it may at first appear, notwithstanding the extreme complexity of its ultimate structure, as a gross object the brain is the easiest of all the viscera for the beginner. It is symmetric, and the main divisions are clearly outlined; moreover its colors are attractive, it retains little blood, the natural odor is not offensive, and it has no unpleasant associations.

If it be legitimate to slaughter animals for food, it is even more so to kill them humanely (as with chloroform) in order to gain information. This is particularly true of the superfluous cats and dogs that lead miserable lives in most cities. Children should be taught that the greatest kindness toward such is a speedy and painless death.

The two following sentences, from an artist and a philosopher, respectively, embody profound truths as to physical and metaphysical methods in any branch of study. According to Philip Gilbert Hamerton, "Personal familiarity alone makes knowledge alive." Joseph Henry declares that "In the order of nature, doing comes before thinking, art before science."

Huxley and Wm. North Rice have emphatically condemned the maxim, "A little knowledge is a dangerous thing." Ignorance alone is perilous, and in proportion to its density.

The practical study of the brain in educational institutions below the college may conveniently form three stages, corresponding with the primary school, the grammar and intermediate schools and the high school. At all three stages actual specimens are to be used and drawings are to be made.

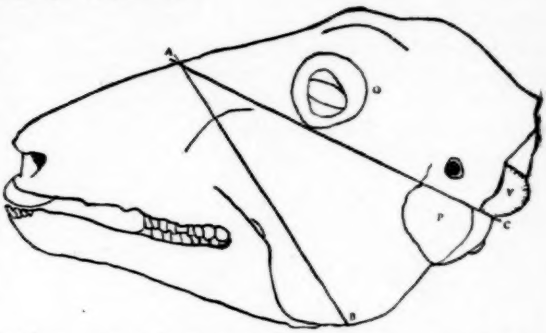

FIG. 2. Head of sheep skinned. Along the line $A-B$ the butcher may cut so as to remove most of the face; the line $A-C$ indicates the plane of section with a saw for removing the cranium.

In the primary stage there is to be mainly *observation* with the unaided eye, and simple manipulation. A sheep's brain* is to be examined by each pupil; but there should be shown also preparations exhibiting the location of the brain in the head, its continuity with the myel (spinal cord), and its connection with the eyes and larger cranial nerves; also preparations, models or charts of corresponding aspects of the human brain. Few terms need be employed, but the parts should become familiar as the features of the face. For further details see the description of an application of the plan in the latter part of this article.

* In most localities where neurology is likely to be considered the heads of sheep may be had in abundance, at a trifling cost, and without involving the killing of the animals for the purpose. In varying degrees the same may be said of calves, pigs and oxen. Sometimes the butchers can be employed to extract the brain after a rough fashion as if for food; but it is removed most safely and easily according to the method devised by P. A. Fish, described by me before the American Society of Naturalists, in 1890, and indicated upon Figures 2 and 3.

In the grammar* school observation is to be extended to *comparison*; with the sheep's brain as a standard the brains of cats and dogs and rabbits are to be examined, drawn and dissected in the same way. All the cranial nerves may be identified. The general nature of cerebral fissures may be considered, and certain special points elaborated, *e. g.*, the distinction between the

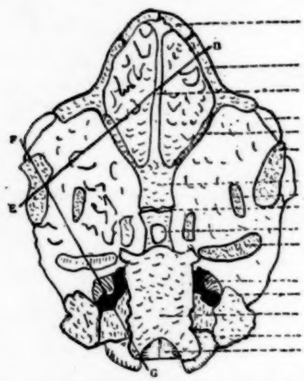

FIG. 3. Ventral aspect of the cranium after removal along the line *A–C*. If the parts outside the line *D–E* and *F–G* are sawn off the brain may be exposed with nippers.

fissures of the cat and of the dog; the difference between the right and the left; the extent of individual variations. Pigs, kittens and puppies† at various ages, before and after birth, may illustrate changes in the form and proportions of parts. A lens may be required for some purposes. The fibrous nature of the white portions may be demonstrated upon hardened specimens.

* In his admirable address, 'Science Teaching in the Public Schools,' (*Amer. Soc. Naturalists*, 1897; *American Naturalist*, September, 1888; also with Appendices, D. C. Heath & Co., 1889), Wm. North Rice assigns the nervous system to the fifth of the nine grades recognized in the primary and grammar schools; but there is also an implication that the study of the brain as an object is to begin in the high school.

† Fetal pigs may usually be obtained at any large slaughter-house.

In the high school, with further observation and comparison should be associated *reflection*. The pupil should be led to recognize the segmental constitution of the brain, and the modifications of the several segments. For this purpose, after a trial of several forms, I believe the brain of the large Green turtle (*Chelone mydas*) of the Atlantic is most available.* The severed heads may be obtained from city hotels, and the brain readily exposed by sawing off the larger part of one side. Afterwards may be studied the brains of other turtles, of salamanders, of lizards and of small mammals, and finally those of frogs and birds. The compound microscope should now be employed for the demonstration of cell-clusters and fiber-tracts in certain regions. In every high school there should be at least one well preserved adult human brain; also that of a monkey. The main resemblances and peculiarities of the former may then be illustrated. Each pupil should have an opportunity of studying the topography of the human cerebrum, and the general arrangement of the fissures should be as familiar as the river systems of his native country. The order of formation of the fissures should be shown upon a series of fetal brains, or models or diagrams thereof.

The foregoing outline is not assumed to be complete or perfect, and the experienced teacher will of course modify the details in accordance with the circumstances.

An opportunity for a partial test of its validity was afforded last spring with a class of forty boys and girls between seven

*Even were the commonly employed brain of the frog not too small, the insignificance of the cerebellum and the secondary fusion of the olfactory bulbs are apt to occasion misconceptions. Indeed, so aberrant is the structure of the frog in most respects that the ease and safety with which it may be obtained, kept alive and experimented upon, constitute a real and considerable bar to the formation and diffusion of sound morphologic ideas.

and eleven years old in the second grade of a primary school. Among the fathers of these children half a dozen are day-laborers and as many more teachers or clergymen, the majority being mechanics or tradesmen.

With the approval of Superintendent H. W. Foster, of the Ithaca Schools, and the cordial cooperation of the teacher, Mrs. H. A. Surface, but with absolutely no advance intimation to the pupils themselves, on the 26th of April there was placed before each of the forty a hardened sheep's brain. During one-third of the half-hour exercise the pupils made drawings of the dorsal aspect of the brain. The rest of the time was spent in discussing the form and naming the main features by the aid of the blackboard. At a second exercise the base was drawn (Fig. 3). At a third each brain had been transected at two levels, *viz.*, between the cerebrum and the cerebellum, and through the frontal part of the cerebrum. After considering the contours and colors of the regions thus exposed, the middle piece was held under water, and air blown into the single orifice in the mesencephal; its escape through the two cerebral orifices demonstrated the continuity of the cavities.

Most of the pupils manifested an eager interest, and only one or two a slight disinclination to handle the specimens.

Twenty names were introduced, nearly in the following order: *cerebrum, cerebellum, olfactory bulb, oblongata, spinal cord,** *arachnoid, pons, chiasma, optic nerve, hypophysis, crus, alba, cinerea, cortex, cavity, endyma, fissure, gyre, pia* and *callosum*. After an interval of nearly two months, at an unannounced examination, most of the pupils were able to recall the main features and their names.

Lest it be hastily inferred that I advocate the introduction of the study of the brain as an isolated branch of biology, let me state, first, that the laws of New York prescribe instruction in physiology for all grades; secondly, that the three lessons above mentioned were merely the last of a series of thirty given by me to the same class, all illustrated by specimens and simple experiments. For the encouragement of others who may desire to further the establishment of objective science teaching in the public schools, it may be added that evidence as to the acceptability of this contribution was received from all parties concerned, *viz.*, the superintendent, the teacher, expert visitors, parents and, by no means least significant, the pupils themselves in the form of spontaneous letters. Two indirect results deserve special mention. The pupils discussed the lessons with their parents (some of whom, by the way, had themselves been my university students); so far from interfering with other work, the interest aroused by the object lessons in physiology was reflected upon totally different branches of study, a point worth considering by those who apprehend that there is no room for science teaching in the public schools.

Appendix: Some educators are concerned as to what shall replace the classics in the curriculums where they are no longer required.* Why not neurology? It is certainly difficult enough, and for most persons —beyond a certain point—it would be quite as attractive and useful. Incidentally, too, there would be learned a by no means insignificant amount of Latin and Greek. This proposition should form the subject of a separate article, but in passing I desire to record publicly the conviction that has been frequently expressed to my colleagues during my twenty-nine years of service, viz., that a certain minimum of both Latin and Greek should constitute a part of the intel-

*Under all the circumstances it seemed best to waive my personal preference for *myel*.

*See, for example, the article, 'After Latin and Greek, what?' in (Boston) *Journal of Education*, XLV., p. 196, March 25, 1897.

lectual equipment of every college graduate; not as entitling him to the name of classical scholar, but as enabling him to comprehend his mother tongue and use it to better advantage, and as facilitating the acquisition of scientific terminology.* That minimum should certainly not be less than what, at my suggestion, has long been required for admission to the two years' course preparatory to the study of medicine at Cornell University, *viz.*, the equivalent of four books of Cæsar's 'Gallic War' and of Goodell's 'The Greek in English.'

BURT G. WILDER.

* Linguistic errors may not vitiate anatomic knowledge, but such inaccuracies as *plexi* as a plural of *plexus*, and *pontic*, *pontine* or *pontal* as the adjective from *pons*, tend to arouse in classical scholars a general distrust of their perpetrators.

THE NATIVE DAHLIAS OF MEXICO.

THE *Dahlia*, botanically speaking, is purely an American genus confined to Mexico. When the Spaniards first visited Mexico they found a people who had advanced considerably out of the state of barbarism. Not only did these people have well-governed towns, but they were agriculturists and horticulturists. They cultivated fruits and vegetables, and in their gardens were many handsome flowers transplanted from the native soil. The Dahlia seems to have been one of these plants. So struck was he by the beauty of this flower that Hernandez, who visited Mexico in 1615, in his History of Mexico, published in 1651, makes mention of two species, one with pale red flowers which grew in the mountains of Quanhuahuac, and was called by the natives *acoctli*. A little over a century later, M. Thierry Menonville, a well-known French botanist of his time, was sent to Mexico by his government to steal the cochineal insect from the Spaniards. While on his dangerous mission Menonville saw the Dahlia on several occasions, and on his return to France, in 1787, published a book of his adventures, in which he spoke of the beauty of the strange flower which he had seen.

About 1788 some seeds of the Dahlia must have been sent to Madrid, for it is recorded that plants flowered for the first time in the botanic gardens of that city in October, 1789. A few of these seeds were secured by Lord Bute and sent to England, where they flowered in 1790. The plants, however, were soon lost, owing to the mistaken idea that they required stove treatment. About this time this species received the name of *Dahlia coccinea*, the generic name being given by Cavanilles, a Spanish priest and one of the most eminent botanists of his day, who was at that time the head of the Royal Gardens at Madrid. The genus was named in 1791 in the Icones Plantarum by Cavanilles in honor of Andreas Dahl, a Swede, a student and disciple of the great botanist Linnæus. Later, Carl Wildenow, objecting to the name *Dahlia*, on account of its similarity to *Dalea*, renamed the plant *Georgina* after Georgi, a Russian scientist and traveller. According to Salisbury, a second species, *Dahlia variabilis*, was introduced into England in 1804 by Lady Holland, who sent the seeds from Madrid. Its behavior under cultivation is described by Salisbury in his paper read before the Horticultural Society in 1808 and printed in the first volume of the Transactions.

The most successful early cultivator of the Dahlia appears to have been Count Lilieur at St. Cloud. He had four distinct varieties to work on in 1808. The experiments of the florists began in 1813, and a writer in a horticultural magazine of 1818 says that with each new year came new varieties until the kinds seemed almost like new creations, so different were they in color and form. Count Lilieur several years before had purples, dark reds, cherry-reds, buffs and

even pale yellow flowers. In 1850 the Dahlia appears to have reached the height of its popularity, after which date it began to decline until the year 1870, when the Dahlia Society founded in that year brought about a revival of interest in the plant. In 1872 additional interest was aroused in the Dahlia by the introduction of *Dahlia Juarezii*, the Cactus Dahlia said to have been obtained from Mexico by a Dutch nurseryman, Donkelaar. The organization of the American Dahlia Society within the last two years has added much to the re-awakened interest in the plant.

As early as 1841 one English dealer had over twelve hundred varieties. This shows the wonderful variability of the plant, which had been in cultivation practically only twenty-seven years. This, however, is not surprising, when we take into consideration the range of variation of the plant in a state of nature. While visiting the Valley of Mexico last summer the writer had the opportunity, as well as the privilege, of botanizing with the veteran botanist and collector, Mr. C. G. Pringle. The slopes of the southern range of mountains known as the Sierra de Ajusco were visited. The Dahlias were found growing in the greatest profusion on the lava beds, known locally as the Pedrigal, literally the Stony Place. Acres and acres of the Pedrigal in the latter part of August are one mass of color of the most varied hues and shades. As the train of the Mexico, Cuernavaca and Pacific Railroad carries you up from Contreras, at the foot of the Sierra de Ajusco, toward the top, where the Valley of Mexico lies spread out before you as a most pleasing panorama, you are carried up through woods that are a wild Dahlia garden—masses and masses of flaming blooms of three species of *Dahlia* in many distinct colors. Here are associated within a small area many beautiful plants with showy flowers, Bouvardias, Senecios, Stevias and the three species of *Dahlia*, viz: *Dahlia coccinea*, *Dahlia variabilis* and *Dahlia Merckii*.

Dahlia coccinea, *Dahlia variabilis* and *Dahlia Merckii* are three of the most common and best known Dahlias which grow in Mexico. Of these *Dahlia coccinea* has the more northerly and by far the most extensive distribution. From the Cordilleras of Chihuahua, within 200 miles of the United States boundary, it ranges southward through the mountains to Jalisco and the Valley of Mexico.* *Dahlia variabilis* is confined to the region around, including the Valley of Mexico. It is a most striking plant, growing from 5 to 6 feet tall, and bearing flowers ranging in color from purple to sulphur-yellow through the following gradations: lavender-purple, heliotrope, heliotrope-yellow (various shades of lighter and lighter hue approaching yellow) sulphur-yellow. The heads of which the ray florets are colored heliotrope-yellow are in reality of an heliotrope color, the bases of the ligulate corolla being of a yellow color shading off into heliotrope. They are broad (1 inch), long (2 inches) and ovate spatulate.

Likewise, *Dahlia coccinea* shows a remarkable variation in color from cardinal of several shades through scarlet, scarlet-orange, mandarin, orange, lemon-yellow, yellow.† The so-called scarlet-orange rays are scarlet with lines of yellow running through, so that the strap-shaped corolla has a somewhat banded appearance. The ligulate corolla is about an inch long and half an inch broad. The entire head varies in size from two inches in the cardinal ones to three inches in the scarlet-orange ones.

Dahlia Merckii runs from purple to pure white through the gradual fading-out of the

*1891, Pringle, *Garden and Forest*, IV., 40.

† These colors have been compared with the colored silk samples issued by Belding & Co. and the Maryland Silk Company, Hagerstown, Md.

purple color. One most commonly sees in a state of nature the white heads which are tinted with lavender or pale purple at the base of the ray floret. The heads in each case are nearly uniform in size, being about an inch and three-fourths across.

There are several other species worthy of mention. *Dahlia imperialis*, *D. scapigera*, *D. dissecta* and *D. pubescens*. *Dahlia dissecta* was discovered by Mr. C. G. Pringle growing on limestone ledges fifty miles east of San Luis Potosi. "It is a very unique species, being scarcely more than two feet high and of bushy habit from an almost woody base." The flower heads are two or three inches broad, with about eight mauve colored rays. *Dahlia pubescens* was found by the same botanist on calcareous bluffs of prairies bordering the valleys of small streams in the State of Mexico and to the north of Toluca. It is a small plant, one and a-half to two feet high, with heads two to three inches broad, with a yellow disc surrounded by eight rays which are purple, with lines of deeper color which changes with age to light purple or dull rose.

The tubers of these plants, particularly those growing on the lava beds along the southern mountainous rim of the Valley of Mexico, are hard to obtain, because of the depth to which they sink in the lava pockets. All of the species store up in their tubers a substance called inulin, chemically allied to starch. The substance is in solution in the cell, much as sugar is, but crystallizes out in needle-shaped crystals upon the addition of alcohol. This substance is stored up as a reserve food to meet the demands of the plant during the active growing season, and the tubers with this stored substance perpetuate the species during the long droughts which are frequent in Mexico.

The dry season in the region of the Valley of Mexico lasts from about the first of October until about the first of June, when there are signs of the returning rainy season. During the drought the tubers of the Dahlias lie dormant until the first rain moistens the soil, when they spring up in great numbers everywhere on the lava beds. The plants grow vegetatively until the end of August, when they flower in the greatest profusion. The rainy season is characterized in the Valley of Mexico by afternoon thunder showers. The morning will be cool, and the air bracing, until evening, when the sky becomes overcast and the rain comes down sometimes in torrents.

A consideration of these meteorological conditions ought to influence the cultivation of the Dahlia, which has not been entirely understood. It will repay some energetic nurseryman to obtain fresh tubers directly from the mountains of Mexico by a personal visit to the native home of the plant. It will repay him to collect tubers of every plant with a different shade of color. As already intimated, the plants in a state of nature are extremely variable. This variation in nature, as compared with the variation produced by cultivation, is just as striking, and shows us that many of the species are in an extremely unstable state of equilibrium as regards their plasticity. This great plasticity in a state of nature explains how so many new colors and forms originated, almost as if by magic, when the Dahlia was first introduced into cultivation. The inherent possibilities of color and form were represented in the protoplasm, and only needed the stimulus of a varied culture to bring out these latent acquired characteristics.

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CURRENT NOTES ON ANTHROPOLOGY.

INSCRIPTION OF THE CROSS AT PALENQUE.

This most famous of all the Mayan inscriptions has been subjected to a searching analysis by Dr. Förstemann (in *Globus*, Vol.

72, No. 3). He reads it in the direction advocated by Rau, beginning at the left upper corner, and confirms Rau's opinion that it is a chronological record. The very large glyph which in this plan comes first he states is a compound of the three glyphs used for the highest customary time-periods of the Mayas, — 360, 7,200 and 144,000 days, and is to be understood as signifying 'time-counter,' or 'historical table.'

The inscription itself is made up of a series of glyphs representing dates; between these is another series representing spaces of time, and a third class of unknown meaning, perhaps historic facts. If the latter, the glyphs would read like the following:

"March 4, 1893; Cleveland, President; 4 years; March 4, 1897."

Or it may be that not historic data, but religious notions are intended, such as the supposed control of a certain period of time by a certain divinity, etc. At any rate, this scheme of the inscription, whatever its application, seems to be well established by this learned and thoughtful article by the most erudite student of the subject living.

THE ETHNOLOGY OF KISSING.

THE kiss was unknown, I think, among the aboriginal tribes of America and of Central Africa. From the most ancient times, however, it has been familiar to the Asiatic and European races. The Latins divided it into three forms—the *osculum*, the *basium* and the *suavium*; the first being the kiss of friendship and respect, the second of ceremony and the third of love. The Semites always knew the kiss, and Job speaks of it as part of the sacred rites, as it is to-day in the Roman Church.

The Mongolian kiss, however, is not the same as that which prevails with us. In it the lips do not touch the surface of the person kissed. The nose is brought into light contact with the cheek, forehead or hand; the breath is drawn slowly through the nostrils, and the act ends with a slight smack of the lips. The Chinese consider our mode of kissing full of coarse suggestiveness, and our writers regard their method with equal disdain.

Darwin and other naturalists have attempted to trace back the kiss to the act of the lower animals who seize their prey with their teeth, etc. An interesting recent study of the subject is by M. Paul d'Enjoy, in the *Bulletin* of the Paris Anthropological Society, Vol. VIII., No, 2.

THE ABORIGINES OF INDIA.

Two articles on the Dravidian stock of Hindostan have recently appeared. One is by Professor Oppert, in Nos. 4 and 5 of *Globus* (Bd. 72); the other by Dr. Zaborowski in the *Bulletin* of the Anthropological Society of Paris (1897, fasc. 2).

Professor Oppert refers to the Aryan invasion of India, and the profound differences between the two stocks which have been maintained by the caste system until the present day. He points out in detail the sharp contrasts in the morphology of the Dravidian and Ayran linguistic stocks, describing the former as concrete, the latter as abstract in its conceptions. Without directly connecting the Dravidian with the Ural-Altaic group, he draws attention to certain similarities between them.

Dr. Zaborowski reviews the recent ethnographical literature of the subject, and argues that the Dravidians of southern India descend from the same family as the Mois of Cochin China and the Malayan tribes of the island world. He supports this from somatic traits, coincidences of customs and religions, and partially from linguistic research. While his article does not carry conviction, it is a result of a careful study of the question.

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UNIVERSITY OF PENNSYLVANIA.

SCIENTIFIC NOTES AND NEWS.

THE ROYAL SOCIETY.

THE ROYAL SOCIETY held its anniversary meeting at the Burlington House on the afternoon of November 30th and its anniversary dinner on the evening of the same day. The medals were presented in accordance with the announcement already made, and the officers were re-elected, with the exception of some members of the Council. The officers elected are as follows: President, Lord Lister; Treasurer, Sir John Evans; Secretaries, Professor Michael Foster, Professor Arthur William Rücker; Foreign Secretary, Sir Edward Frankland; other members of the Council, Professor William Grylls Adams, Professor Thomas Clifford Allbutt, Sir Robert Stawell Ball, Rev. Thomas George Bonney, Professor John Cleland, Professor Robert Bellamy Clifton, Professor James Alfred Ewing, Alfred Bray Kempe, John Newport Langley, Joseph Larmor, Professor Nevil Story Maskelyne, Professor Raphael Meldola, Professor Edward Bagnall Poulton, William James Russell, Dukinfield Henry Scott, Professor Walter Frank Raphael Weldon.

Lord Lister delivered the anniversary address, beginning by enumerating the fellows and foreign members who had died during the year, and paying a tribute to those whose scientific services had been the most noteworthy, including Sylvester, Sir Augustus Wollaston Franks, the Rev. Dr. Houghton, Edward Ballard, James Heywood, Weierstrass, DesCloizeaux, Julius von Sachs and du Bois-Reymond.

Lord Lister then proceeded to report on the activities of the Royal Society during the year, including the address of congratulation presented to the Queen, the deputation of the Society to urge upon the government the establishment of a National Physical Laboratory, and its relations with the India office in regard to the treatment of the plague. Lord Lister further referred to Dr. Copeland's researches on variola and vaccinia and to the contributions collected by the Society for the National Pasteur Memorial. At the anniversary dinner toasts were proposed or responded to by the President, Sir John Evans, the Duke of Devonshire, the American Ambassador, Professor Forsyth, Lord Kelvin and Professor Campbell.

THE NEW YORK STATE SCIENCE TEACHERS' ASSOCIATION.

THIS Association will, as we have already announced, hold its second annual meeting at Ithaca on December 30th and 31st, following the sessions of the American Society of Naturalists and the affiliated societies. The objects of such an Association should commend themselves to all men of science, and it is hoped that as many as possible attending the other meetings will remain at Ithaca over Thursday and Friday, and that all resident in New York State will join the Association. The program arranged for the meeting is as follows:

Thursday afternoon at 3 p. m., address of welcome by President J. G. Schurman; paper by Miss Mary E. Dann, of the Girls' High School, Brooklyn, on 'Physical Laboratory Work in Secondary Schools.' Discussion opened by Professor John F. Woodhull, Teachers' College, New York; followed by Professor D. L. Bardwell, Cortland Normal School, and Professor Irving P. Bishop, of Buffalo Normal School.

At the evening session, in the Physical Lecture Room, an address will be given by the President of the Association, Professor Nichols, on 'The Use of the Lantern in Science Teaching' (illustrated by numerous experiments). After the evening session there will be an informal reception at the house of the President.

On Friday morning the report of the committee of nine will be presented on the three following subjects: (1) The recognition of science as a requirement for entrance to Colleges. (2) Science courses for secondary schools. (3) Nature study in elementary schools. A paper by Professor L. M. Underwood, of Columbia University, on 'The Teaching of Botany in Secondary Schools,' will be followed by a discussion by Miss Sarah V. Chollar, of Potsdam Normal School, and Professor W. H. Lennon, of Brockport Normal School.

In the afternoon there will be round tables for the discussion of science teaching, as follows: I. 'Union Schools and Academies,' led by Principal Thomas B. Lovell, of Niagara Falls High School. II. 'Normal Schools,' led by Professor Howard Lyon, of Oneonta Normal School. III. 'Colleges,' led by Professor B.

G. Wilder, of Cornell University. The final paper will be on 'Out-door Science Work in Secondary Schools,' by Principal Frederick A. Vogt, of Buffalo Central High School. Discussion opened by Professor A. D. Morrill, of Hamilton College, Clinton; followed by Professor Chas. B. Scott, of Oswego Normal School, and Professor R. A. Surface, of Cornell University.

A NATIONAL DEPARTMENT OF HEALTH.

THE New York Board of Trade and Transportation has addressed a circular letter on public health and quarantine to the Governors of States, to the Mayors of all important cities, seaboard and interior, and to all State and municipal health authorities, physicians, and known experts on the subject, asking for opinions as to the desirability of creating a national department of health, and requesting suggestions as to the best method of protecting the public health, especially as the same affects interstate commerce, on the following lines:

(1) Quarantine status and administration in foreign countries as furnishing precedents for the United States. A, border; B, internal.

(2) The present status of quarantine in the United States. A, border defence; B, interstate; C, state and local.

(3) The existing system of quarantine administration in the United States. A, cost; B, injury to and restrictions imposed on commerce and travel; C, security afforded.

(4) Legislation needed for lessening injury to and restrictions on commerce and travel, and to afford greater security to the country. A, increase power of Marine Hospital Service and how; or, B, create a national department of health; or, C, create a national department of commerce, with a bureau of health; or, D, other suggestions.

(5) The power of Congress under the Constitution to regulate matters affecting the health of the people. A, national; B, interstate; C, State and local.

THE PROTECTION OF THE SEA OTTER.

THE Treasury Department has recently issued an important and interesting 'Report on the Sea Otter,' by Capt. C. L. Hooper, of the revenue marine, giving an account of its range, habits, method of capture and decrease under American rule almost to the point of extermination. From 1873 to 1883 the annual catch increased from 2,265 to 4,152, and then, as the inevitable result of overhunting, rapidly declined, the catch for 1896 being only 724. So sharp has been the pursuit of this valuable animal that it has changed its habits, no longer coming on shore to feed, rest, or bring forth its young. As about 1,200 natives of the Aleutian Islands are almost wholly dependent on the sea otter for the necessaries of life, it is highly important to make some effort to preserve it, and to do so promptly. With this end in view, a set of regulations for 1898 are appended, intended to preserve the remaining sea otters for the use of the Aleut hunters and their families, in accordance with the spirit of article 1,956, Revised Statutes. The Report is accompanied by a map showing the sea otter grounds, which lie mainly to the southwest of Kadiak and in waters considered to be within the jurisdiction of the United States. If so, the proposed regulations, properly enforced, will furnish ample protection; if not, an international agreement would be necessary and a limit of fifteen miles from shore. The remaining otter would then be protected, and hunting from schooners being prohibited, the natives would be compelled to hunt from the shore, and the otter would have some chance of increasing.

GENERAL.

WE record with regret the death of the Hon. Gardiner Greene Hubbard, at his residence near Washington, on December 11th, in his 76th year. He was President of the National Geographic Society, whose great success was almost entirely due to his efforts, and was prominent in all movements for the advancement of science at Washington. The first series of this JOURNAL was greatly indebted to him for his counsel and financial support, it having been established by him and Professor A. Graham Bell.

A BUST of Pasteur was unveiled on November 28th at Melun as a memorial of his antianthrax vaccine. On the same day a memorial to him was also unveiled at Boulogne, an address being made by M. Gaston, Paris.

AT the anniversary meeting of the Royal Society Lord Lister announced that Sir William Mackinnon, late Director-General of the Med-

ical Department of the Army, had, by will and codicils dated 1896 and 1897, after making certain specific legacies, including one of £2,000 to the University of Glasgow, bequeathed the whole residue of his property to the Royal Society, subject to certain life annuities. The proceeds of the fund were to be applied by the Royal Society for the foundation of such prizes and scholarships for the special purpose of furthering natural and physical science, including geology and astronomy, and for furthering original research and investigation in pathology, as the Society might think best and most conducive to the promotion of those sciences and of original discoveries therein; such prizes and scholarships to be called after the name of the testator.

THE Berlin Academy of Sciences has made a further appropriation of 3,000 M. for the History of the Academy now being prepared by Professor A. Harnack.

E. CZABAN, a Warsaw merchant, has bequeathed 50,000 roubles (some $35,000) to the Warsaw Academy of Sciences and also 30,000 roubles to both the University of Cracow and the University of Lemburg.

THE Indiana Academy of Science will hold its annual meeting at Indianapolis on December 28th, 29th and 30th, under the presidency of Professor Thomas Grey, Terre Haute, Ind.

THE Lick Observatory eclipse expedition, from San Francisco, has arrived at Bombay and will proceed inland to select an observing station.

IT is reported that an endeavor will be made to found an astronomical observatory at Glasgow.

THE Marine Biological Station of the University of Tokyo, at Mazaki, will be removed during the present year to a new site about two miles north of the present location. A proposed railway will bring the station within two or three hours of Tokyo.

A MARBLE bust in memory of the geologist A. Stelzner has been unveiled in the School of Mines at Freiburg.

IT is proposed to commemorate the late Mr. J. Greig Smith, M.A., M.B., C.M., Aberdeen, professor of surgery at University College, Bristol, by erecting within the precincts of the University of Aberdeen a memorial tablet.

DR. CAMPBELL MORFIT, the chemist, died on December 8th in London. He was born in Herculaneum, Mo., November 19, 1820. He was formerly professor of applied chemistry in the University of Maryland. In 1858 he removed to New York, where he followed his profession until 1861, when he went to London.

THE death is announced of Mr. Ernest Giles, the Australian explorer, who between 1874 and 1875 twice traversed the West Australian desert from Adelaide to Perth. The Royal Geographical Society awarded him its founder's medal for his journey.

BILLS have been introduced in both branches of Congress prohibiting pelagic sealing by citizens of the United States.

SECRETARY LONG has issued an order transferring the Naval Hydrographic Office from the control of the Navigation Bureau to the Bureau of Equipment. The latter bureau now has charge of the Naval Observatory and similar branches of the service.

ONE hundred employees of the Gypsy Moth Commission have been discharged, the appropriation made by the Legislature being nearly exhausted.

LIEUTENANT R. E. PEARY, having again complained in London of Captain Sverdrup's unfairness in going to Smith Sound next summer, Captain Sverdrup explains that he wrote to Mr. Peary some time ago saying that he did not aim to reach the pole, but only intended to explore Greenland and to make a study of the ice.

THE Zurich correspondent of the London *Times* writes that at Windisch the old Roman colony of Vindonissa, in the Canton of Argovie, excavations recently carried out under the auspices of the Swiss Archæological Society have yielded important results. Large Roman villas and an amphitheatre have been disinterred and, besides a large quantity of coins, pottery, bronze and ironware, some large silver vessels have been discovered, which are said only to have their equals in the famous treasure-trove

of Hildesheim, in Germany, brought to light in 1868.

THE daily papers report that uranium has been discovered near Black Hawk, Col. The mineral is worth $1,500 per ton, and the agents of a French syndicate have announced that they will buy all that can be produced, as it is much desired by the French government for hardening and solidifying gun metal and armor plate.

THE American Forestry Association held its 16th annual meeting at Washington on December 8th. General Francis H. Appleton, of Boston, presided and made an address. The chairman of the Executive Committee, Dr. E. B. Fernow, presented a detailed report, reviewing especially the legislation of the past session of Congress. The Association proposes to establish a monthly journal, *The Forester*, devoted to the interests which the Association is doing so much to forward. The summer meeting of the Association will probably be held at Boston, in conjunction with the American Association for the Advancement of Science.

THE British Institution of Electrical Engineers, which now numbers 3,000 members, held its annual dinner on November 24th. Addresses were made by Lord Kelvin and others.

IT is expected that the life of Pasteur by his son-in-law, M. Vallery Radot, will soon be ready for publication.

M. ALCAN announces, in the next volume of the French edition of the 'International Scientific Series,' a work on the physiology of hearing by Dr. Gelle.

THE *Open Court* continues in the December number the series of portraits of mathematicians, with the reproduction of an old steel engraving of Lagrange, of whom Dr. T. J. McCormack gives a biographical sketch.

AT the anniversary dinner of the Royal Society on November 30th Lord Kelvin referred to the presence of representatives of many foreign powers and of the Ambassador of the United States, who, he said, 'could not be regarded as a representative of a foreign nation.' In his address at the dinner Lord Lister remarked: "That among the great number of eminent Americans who attended the Canadian meetings of the British Association and the Medical Congress there was never a jarring note; there was never anything but cordiality and kindly feeling towards the old country."

MAJOR M. P. HANDY, special commissioner to gather information regarding the Paris Exposition of 1890, recommended the appropriation of $915,000 towards the expenses of preparing a proper representation for the United States. The sum includes $1,500 per year for three years for each of nine scientific experts. In his report Major Handy says: "The industrial progress of the United States, and the evolution of its material resources during the hundred years which the Exposition is to crown, has been unequalled by that of any other nation. It is not too much to say that the United States now stands the greatest nation of the world in all the great lines of industry. According to the figures given by the eminent statistician Mulhall in his 'Industries and Wealth of Nations,' the United States leads in agriculture, with products greater than Russia and the United Kingdom combined; in the manufactures with a product of greater value than the aggregate output of the factories of the United Kingdom, France, Austria-Hungary and Belgium combined; in machinery with a greater steam power than the United Kingdom, Austria-Hungary and Italy combined; in mining with a product greater than the United Kingdom and France combined, or nearly one-third of that of the entire world; in railway transportation with a mileage 40 per cent. greater than that of all Europe; in forestry with products greater than that of all Europe, and nearly one-half of the total products of the world; in fisheries with a greater product than the United Kingdom, Russia and Germany combined."

THE English papers report that the Guilford Natural History Society have been considering the question of the preservation of Wolmer Forest, which is only fifteen miles from that town, and have decided to present a petition to the Commissioners of Woods and Forests, praying that Wolmer Forest may be reserved as a sanctuary for wild birds, in which they, their nests and eggs may remain unmolested

throughout the year; that it may not be let at any time for game preserving, or for any purpose inimical to bird life; and that it may remain in perpetuity as a national memorial to the greatest outdoor naturalist England has produced—Gilbert White, of Selborne. Such a recognition, the Society urge, would show that the admiration of Gilbert White in the nineteenth century was so practical as to be of value to the naturalist and the English-speaking race for all succeeding time. The Society have no wish to attempt to interfere with the use of the Forest by the War Office for the purposes of military manœuvres.

UNIVERSITY AND EDUCATIONAL NEWS.

Bills have been again introduced into both Houses of Congress to establish the University of the United States. Such a bill was introduced by Senator Edmunds in 1890 and referred to a select committee, which reported unanimously in its favor. The standing committee since appointed has also reported unanimously in its favor and it is said that the bill will probably be passed during the present session.

Negotiations are said to be under way looking towards the affiliation of the University of Chicago and the Rush Medical College.

Evelyn College, Princeton, has been closed, owing to the fact, as stated by the principal, that Princeton University refuses to recognize any work for the education of women.

Mr. Franz Kempe, of Stockholm, has given the University of Upsala the sum of about $45,000 for the establishment of an associate professorship of physiological botany under the condition that Dr. Lundström be the first incumbent.

By the will of the late F. Ulrich the German University of Prague receives 100,000Fl. for the distribution of scholarships.

A proposition has been introduced into the French Chamber and referred to the Education Commission creating a chair of colonial science in the University of Paris.

Professor Waldemar Lindgren, of the U. S. Geological Survey, has been appointed to the chair of metallurgy and mining engineering in Stanford University.

Mr. Edgar R. Cumings, of Cornell University, who graduated from Union College last June with honors in geology, has been appointed instructor in geology in the University of Indiana.

Dr. W. Ophüls, assistant in the University of Göttingen, has been called to the chair of pathological anatomy in the University of Missouri.

Dr. S. Fuchs has been promoted to an associate professorship of physiology at the University at Jena.

The regents of the University of the State of New York have just published as bulletin 38 a compilation of all the laws, ordinances and by-laws pertaining to higher education in this State. It includes not only the University law, but also the educational articles from the Constitution and the various statutes governing professional education and license to practice, and other allied matters. Its practical utility is greatly increased by many annotations and cross references and by a very full index, so that every lawyer or school officer will find it indispensable when considering any of the large class of questions covered. It is being sent to every institution in the University free, but lawyers or others interested may obtain copies from the regent's office, post free, at the nominal price of 15 cents for the 108 pages.

The report of the Sites Syndicate of Cambridge University was approved on November 25th. By it provision was made for sites for the erection of a law school, for new buildings for the department of botany, for a museum of general and local archæology and of ethnology, to be erected on ground purchased from Downing College. The mathematical professors are to be provided for by buildings to be erected on the site purchased from Messrs. Murtlock & Co., while the rooms now occupied by them are to be assigned, together with the bird room, when vacated, to the department of morphology. The rooms between the bird room and the department of physiology are to be assigned to the departments of physiology and morphology. The present Geological Museum in Cockerell's buildings and the rooms in Scott's buildings occupied by the University for business pur-

poses are to be appropriated to the University library as soon as they can be vacated. The site now occupied by the old Anatomical School, part of the pathological department and a portion of the unoccupied part in Downing street is to be reserved for the erection of new buildings for the medical, surgical and pathological departments.

DISCUSSION AND CORRESPONDENCE.

THE UNITED STATES FISH COMMISSION.

THE recent editorial of SCIENCE on the subject of the United States Fish Commission is unfortunately misleading in some of its statements, and, in justice not only to the Commissioner but to the entire personnel of the Commission, these should be corrected.

While the amount of scientific work accomplished under the direction of the Commission may not be as great as men of science might wish, it must be remembered that, after all, the primary object of the Commission is to preserve and increase the fisheries, and, so far as this can be accomplished by artificial propagation, this has been done. Moreover, it should be borne in mind that, aside from salaries, the sum to be expended in any one branch is determined by the appropriation committee, and the appropriation for 1898 contained $132,000 for the propagation of food fishes and but $10,500 for scientific research.

A comparison of the annual reports for a few years back will show that it is hardly just to say that 'the efficiency of the hatcheries and of methods of distribution cannot be advanced or even maintained.' In regard to the oyster the work of Dr. J. A. Ryder and others under the Fish Commission is well known, and it may be said that the investigations of the past two years compare favorably with those of previous years, and that important reports on the subject have been published.

In regard to the lobster it is hardly correct to say that 'we are not told how many eggs are killed at the hatcheries,' when the report of the Commissioner definitely says that '128,000,000 eggs were secured, producing 115,000,000 fry.' The rest of the matter is unjust because, as in the case of shad, the eggs were *all* obtained from animals taken for market, and had they not been purchased by the Fish Commission the eggs would have been a total loss to mankind, and the adult lobster would have been killed instead of being returned to the water. While the sale of 'berried lobsters' is prohibited by law, very little regard is paid to the statute, as it is an easy matter to scrape off the eggs and sell the females without running the least risk. Instead of the work being analogous to 'taking all the babies born in New York City and depositing them in a baby farm,' it is like rescuing them from 'baby farms' and worse, and transferring them to a municipal orphan asylum.

That the Commissioner of Fisheries should have a practical and scientific knowledge of fishes is undeniable, but meanwhile let us at least be just to the present one. F. A. L.

[CERTAINLY the Fish Commission should be given its due. It is, as we stated in the article referred to, doing a useful work in the distribution of fry, but does F. A. L. really believe that this can be done in the most satisfactory manner under the direction of one ignorant of the life-history, habits and natural environment of fishes? What does F. A. L. regard as the probable outcome, should all the scientific departments, bureaus and surveys at Washington be placed under the charge of professional politicians and their relatives and supporters? Dishonesty would soon follow inefficiency, and the present condition of the Fish Commission, bad as it is, would be looked back to as relatively ideal. In mentioning Ryder our correspondent calls attention to work of the kind that the Commission is no longer able to carry out. If we differ from F. A. L. as to the efficiency with which the lobster is propagated, is the present Commissioner competent to decide who is right? We have no wish to suppress discussion in this JOURNAL, but it is unfortunate if men of science cannot unite in maintaining principles on which depend the scientific and economic work under the government.—ED. SCIENCE.]

A NATIONAL DEPARTMENT OF HEALTH.

TO THE EDITOR OF SCIENCE—In the excellent article on 'The Progress and Achievements of Hygiene,' in your issue for November 26th, there is an error of omission which, whether intentional or not, should not be allowed to pass uncorrected in a journal so prominent as SCIENCE.'

On page 796 the writer says: "Since Congress has failed to act upon the President's repeated recommendation and the petitions of numerous medical societies for the creation of a National Health establishment, there is no good reason why the scope of duties and powers exercised by the Marine Hospital Service should not be enlarged;" making no allusion, whatever, to the comprehensive bill recently drawn up by the American Medical Association, to be urged before the present session of Congress.

The bill, as formulated, provides for an independent department, of which the Marine Hospital Service shall constitute, as it should, a subordinate bureau.

The conservation of the public health, considered even from a purely economical standpoint, is of national importance and should be relegated to no subordinate bureau with or without 'an advisory board.' To do so would be to postpone, perhaps for decades, the imperative and rational step which should be taken now.

The head of the new department ought to be made a cabinet adviser, but perhaps this may not be at present. If necessary, the Constitution can and will in time be altered to give it additional powers consonant with the requirements of modern sanitary science. To quote Dr. Girdner in the *North American Review* for the present month, what is needed is: "A unifying and supervising force in the national government which will direct, harmonize and render efficient the agencies of the various States."

C. H. PRESTON.

DAVENPORT, December 7, 1897.

SCIENTIFIC LITERATURE.

Habit and Instinct. By C. LLOYD MORGAN. London, Edward Arnold. 1896. 8vo. Pp. 352.

This is a work on comparative psychology largely based on observations of bird life, and containing appropriate speculations concerning the origin and development of certain mental phenomena. The press work is excellent, the one illustration fair and the binding poor.

In the preface Professor Morgan makes a gracious allusion to those whom he met during his lecture tour, and he shows throughout the entire book an appreciation of, and a remarkable familiarity with, the work of American biologists. This may be due to the fact that 'Habit and Instinct' is the embodiment, in book form, of a series of lectures delivered in various university centers of the United States; but one experiences an exhilarating sensation of novelty in reading a book on modern biological problems which is neither supported by the legs of Lord Morton's mare nor infested with bob-tailed mice and epileptic guinea pigs.

First, defining his use of such terms as habit, instinct, reflex action, connate and deferred activities, automatism, etc., he divides the animal activities into those which are inherited and those which are acquired. From the biological point of view, habits are acquired activities of the individual, while instincts are congenital activities not characteristic of the individual alone, but of all the members of the group to which the individual belongs.

The first third of the book is largely descriptive of the habits of young birds and mammals, the birds in particular being selected from representative groups. The anecdotes are told in a most entertaining manner, but one fears that, as the embryologist drew many false conclusions from data supplied by the highly specialized meroblastic egg of the hen, so the comparative psychologist may be deceived by the data furnished by the highly specialized mental equipment of the bird. Though the observations would doubtless prove less entertaining, it is in the lower rather than in the higher vertebrates that one would search for the more simple and less involved mental phenomena. The anecdotes are generally pertinent, but a half page of speculation as to how a pig would jump out of a chair is neither instructive nor conclusive.

Having arranged his data, Professor Morgan really begins his work in the sixth chapter,

where he maintains that the first instinctive act (for example, the first peck of a newly hatched chick), the more automatic result of an inherited motor coordination, supplies to consciousness its first experience-data. "This is due to complex groups of incoming currents, from the parts concerned in the response, along afferent nerves to the sensorium." On this first occasion the consciousness arises wholly by back-stroke. "On subsequent occasions, under associative suggestion, revivals in consciousness of previous experience-data modify the whole process and introduce the effective guidance of consciousness," * * and * * "This profiting by individual experience is of the very essence of intelligence."

If the revivals in consciousness are pleasurable the activity is augmented; if unpleasant or painful it is inhibited. The repetition of the act becomes, then, a matter of conscious choice, and through reiteration the action becomes ingrained and habitual. "On this conscious selection and choice depends * * * the development of those habits which are acquired as opposed to those which are congenital; and * * * the whole mental as contrasted with merely biological evolution."

In treating of imitation, while it is admitted that there may be imitative organic response, independent of experience, the incentive to intelligent imitation is the pleasurable sensation which the imitator receives when his acts resemble the acts of others. The tendency to imitate is thus based on an innate proclivity, and is the means of securing to the organism a congeries of acquisitions which, perfected through repetition, may finally become habitual. In the opinion of Professor Morgan, already expressed in an earlier work, the value to the organism of the imitative tendency is vital. On its presence the questions of survival or destruction frequently depend, for the imitation of the quick-witted and alert is often the salvation of the more stupid. In gregarious animals, through 'tradition,' acquisitions are handed down from generation to generation without the aid of hereditary transmission.

The motif in the chapter on 'Emotions' is the elaboration of the theory of James, namely, that the emotion originates, is primarily generated, by a back-stroke from the motor organs and viscera, and thus 'all the data of sense experience are of peripheral origin.' Though Morgan's observations appear to be in accord with this view, the reader may not feel thoroughly convinced that the emotions are universally the conscious effect of the back-stroke from the visceral actions.

In the succeeding chapter the author shows that though an emotion is private to, and exclusively for, the individual receiving the back-stroke, the subsequent 'expression' may be, and often is, an indication to others of the particular emotional state. "So long as the expression indicates an emotional condition which shows that the animal means business, that is enough from the biological point of view." He thus incidentally reconciles Wallace's theory of exuberant vitality with commonplace sexual selection. Exuberance of vitality may be expressed, on the one hand, by emotion (song, etc.), and, on the other, by peculiarities of structure (plumes, etc.). Both may be of varying potency in arousing the sexual instinct of the opposite sex, and thus of varying selective value. "Stripped of all of its unnecessary æsthetic surplusage, the hypothesis of sexual selection suggests that the accepted mate is the one that most strongly evokes the pairing instinct."

The view is advanced that the song of birds, unlike their calls and alarm notes, may be 'traditional' and due to imitation; and the question of the instinctive nature of the peculiar antics and aërial evolutions of certain birds, before and during the breeding season, is raised. But 'in all these matters further and fuller evidence from direct observation is to be desired.'

The sordid questions of domestic economy, nest-building, incubation, the care of young, etc., are now discussed and the questions raised: Are these phenomena instinctive or are they intelligent? Are they congenital or are they the result of individual experience? If instinctive, are they attributable to natural selection alone, or to the inheritance of acquired habit? So far as certain of the phenomena are concerned, the author favors a possible cooperation of natural and intelligent selection, though he concludes that as matters stand 'the ques-

tion must be left open.' Questions arising in connection with the migratory habit are left in a similar way.

Professor Morgan now lays special stress upon consciousness as a cooperating factor in organic development. In the earlier chapters it was assumed, for the sake of simplicity, that mental evolution might be concomitant with, rather than a factor of, organic evolution. His presentation of the difference between organic evolution as a result of the elimination of the unfit, and of organic evolution as a result of conscious choice, through the elevation of the fit, is extremely ingenious, and the part that the latter may play in the struggle for existence is clearly shown. "In so far as conscious adjustment aids in the struggle for existence, in so far through it the animal is better able to escape danger, to secure a more favorable habitat, to gain a mate and beget progeny; the animal possessed of intelligence will escape elimination, transmit his power of conscious adjustment, and contribute to the propagation of his race. Without fully subscribing to the doctrine of the all-sufficiency of natural selection, we may yet say that natural selection will exercise a determining influence in deciding the course which conscious adjustment must take."

The question of the inheritance of acquired habits is many times raised, but receives no partisan treatment in the first three hundred pages. In the latter part of the book the author instinctively holds to his earlier belief, while admitting, as a result of his experience, certain intelligent modifications of his views. We quote from page 305:

"If pressed to summarize my own opinion on this question, I should say: First, that there is but little satisfactory and convincing evidence in favor of transmission, but that variation does seem in some cases to have followed the lines of adaptive modification, so as to suggest some sort of connection between them; secondly, that there are many instincts relatively definite and stable which may fairly be regarded as directly due to natural selection, though here again, if we could accept the view that adaptive modification marked out the lines in which congenital variation should run, our conception of the process of their evolution would be so far simplified; thirdly, that there are some peculiar traits, also seemingly definite and stable, which can only be attributed to the indirect effects of natural selection."

In the discussion of *modifications* and *variations* the author follows Mark Baldwin in defining the former as acquisitions which occur in the course of individual life, and the latter as those changes in the individual which are the result of some disturbance in the germinal substance. Mental phenomena are laid aside for a time and the more easily apprehended arguments and illustrations from structure adopted. The author dwells at considerable length upon the claims of the extreme Neo-Darwinians, on the one hand, and the extreme Neo-Lamarckians, on the other, and concludes that "all this is very interesting, and affords considerable scope for ingenuity. But it does not touch the question at issue, and this is, not which method is apparently the most advantageous; not which method we should have adopted had the work of creation been entrusted to our care, but which has been adopted by nature." Weismann's principles of *germinal* and *intra-selection*, Baldwin's *organic selection* and the author's *innate plasticity* indicate the neutral ground where selectionists may meet transmissionists; where fortuitous variations may finally take the place of mere temporary adaptive modifications.

Professor Morgan's entertaining style, his originality of experiment, his quick interpretation, his rare quality of explanation and the comparative novelty of his subject will give 'Habit and Instinct' a place beside 'Animal Life and Intelligence' in the library of every working biologist. HERMON C. BUMPUS.

Das Nördliche Mittel-Amerika, nebst einen Ausflug nach den Hochland von Anahuac. Von DR. CARL SAPPER. Braunschweig, Vieweg und Sohn. 1897. With maps and illustrations. Pp. 436.

The studies of Central American geography and ethnography which Dr. Sapper has contributed to *Petermann's Mittheilungen*, *Globus* and other periodicals, from time to time during the last ten years, have made his name familiar to all interested in the products and history of that portion of our continent. In the volume

before us he has gathered many of these articles together, added others not heretofore published, and appended thirty pages of vocabularies of the native tongues, specimens of Indian music and various statistical matter (rainfall, culture products, etc.).

The descriptions of travel and of the manners of the present inhabitants are vivid and well told, but for scientific purposes the articles on the native population will have the higher interest. These embrace a discussion on the independent native States in Yucatan, the commercial relations of the Indian tribes in northern Central America, the present Indian geographical names in the same area, the ruins of aboriginal towns and fortresses there found, the music and dances of the existing tribes, and special articles on the Lacandons and Kekchis, two branches of the Maya family which Dr. Sapper had unusual opportunities to observe.

The information he gives on all these subjects is abundant and drawn from his own studies. Especially his article on the architectural principles indicated in the ancient ruins, and the connection of the culture areas which they indicate, is replete with new and instructive suggestions. It is amply illustrated by a number of designs in the text.

The maps are eight in number and show respectively the location of volcanoes, the distribution of vegetation forms, the elevation of land, the cultivation of commercial plants, the extension of languages, the independent Indian tribes, the native names and the ancient ruins of northern Central America.

In the final paper of the volume the author ventures on the important question as to the original seat of the Mayan culture and language. He gives substantial reasons for saying it was *not* Yucatan, which peninsula he thinks was first occupied by the Mayas about the fifth century of our era; nor was it Guatemala, Tabasco, or the territory of the Huastecas, north of Vera Cruz; but most likely the highlands of Chiapas (in which he agrees with Dr. Schellhas). He considers the adoption by the Mayas of a sedentary and agricultural life to date from a remote antiquity, and conclusively disproves the prevalent notion that it was originated or deeply modified by either 'Toltecs' or Nahuas.

The extended vocabularies include a large number of 'culture words' from the Mayan dialects, and were in great part collected by himself. They add considerably to the value of this excellent work.

D. G. BRINTON.

UNIVERSITY OF PENNSYLVANIA.

Wild Neighbors. By ERNEST INGERSOLL. New York, The Macmillan Co. 8vo. Pp. xii+301. 29 illustrations. $1.50.

Mr. Ingersoll's 'Wild Neighbors' are some of our native mammals, the red and gray squirrels, panther, coyote, badger, porcupine, skunk, woodchuck, raccoon, and incidentally many others, with which the author endeavors to make us better acquainted through interesting accounts of their habits. The biography of each species contains some descriptive notes and extended life histories, covering general habits, distribution, economic importance, and comparison with other species. The skunks of the genus *Mephitis* are compared with the mink, the European polecat, the stinking badger of East India, the honey badgers of South Africa, and our more closely related genera, *Conepatus* and *Spilogale*. One chapter is devoted to 'the service of tails, their use and importance to various creatures,' and is extended to include birds, reptiles, insects and crustaceans, as well as mammals. One is given to animal training and animal intelligence and deals mainly with domesticated species and those of the menagerie, discussing their capacity for learning.

The work brings together many interesting facts from the lives of our best known mammals in a popular style, with technicalities carefully omitted. To those who have had little to do with mammals or mammal literature it will prove new and interesting, a great part being taken by direct or indirect quotation from the works of Audubon and Bachman, Kennicott, Lord, Goode, Thoreau, Burroughs, Coues, Allen, Roosevelt, Merriam, Hornaday, Bicknell and many other well known authors. Unfortunately, however, less reliable sources have been drawn upon also and many misleading statements are made. The reader is told that the Eastern chipmunk (*Tamias striatus*) is now conceded to be the only species ranging between the Atlantic and

Pacific coasts, while in reality some 22 species and 12 subspecies are now recognized in the United States. The nuthatches are erroneously classed with the woodpecker as birds that use their tails for support in climbing over the trunks and branches of trees. Young opossums are said to go about clinging to their mothers' tails soon after they are born.

The book contains much that is good in its way; but unless the reader exercises more knowledge of mammals than the author seems to possess, he will be unable to decide what should be accepted as reliable and what rejected as unreliable. To the student of mammals if offers nothing in the way of new and original matter. The nomenclature is out of date, a large proportion of the generic and specific names differing from those in present use.

The author has experienced the usual difficulty in obtaining illustrations of mammals. The few that appear to be new are evidently taken from badly mounted specimens and are wretchedly drawn. The reproductions from previous works are not the best that might have been selected, and in most cases the reader is left to guess where he has seen them before.

VERNON BAILEY.

SOCIETIES AND ACADEMIES.

BOSTON SOCIETY OF NATURAL HISTORY.

A GENERAL meeting was held November 17th, seventy-one persons present. Dr. B. L. Robinson spoke of the flora of some of the islands of the Pacific, noting the various classifications of islands proposed and mentioning examples of the different classes. Insular floras show a paucity of species compared with genera; Leguminosæ are rare on oceanic islands. Dr. Robinson sketched the history of botanical exploration of the Galápagos and prefaced the result of his work upon the collections of Dr. Baur with an account of the classic studies of Hooker and Andersson. The flora of the upper, moister portions of the Galápagos is closely related to floras of Central America, Mexico and the West Indies, while in the lower, or desert portions, the flora has been derived from Peru and Chili. Dr. Robinson also gave a brief account of the flora of some of the Californian islands, and mentioned their resemblance to the flora of the Galápagos in the number of endemic types. The study of the flora of the Californian islands confirms Le Conte's theory that they were united with the main land up to Quaternary times.

Professor A. E. Verrill discussed the causes that determine the flora and fauna of the smaller islands off the New England coast, referring particularly to the Thimbles and other islands in Long Island Sound. The islands north of Cape Cod differ from those south of the Cape, though both are governed by the same principles; compared with the mainland the animals are few in number. The meadow mouse, *Arvicola sp.*, is the most important factor in regard to the flora, though the introduction of sheep and goats does much to change the vegetation. Many birds found on the Thimbles do not breed upon them. Reptiles are entirely wanting, and when introduced do not survive. With the exception of the red-backed Salamander, *Plethodon*, there are no Amphibians; the *Plethodon* is abundant and is frequently found associated with marine Crustaceans. The surface soil, though rich and black, did not originally contain earthworms; introduced later, they are now abundant. The larvæ of Scarabæidæ and Myriopods belonging to *Spirobolus* and *Polydesmus* were exceedingly abundant and replaced the earthworm. The *Polydesmus*, owing to the lack of fresh water and to the effect of salt water, is now extinct on the Thimbles. With insects the number of species is small; they swarm more rapidly and are more injurious than on the mainland. Of the Mollusca, two *Helices* and a *Succinea* abound; slugs are wanting. The plants are the same as those of the mainland, but only a limited number can withstand the adverse conditions caused by the salt spray, ravages of mice, drought, action of storms, etc. Certain plants are more hardy, grow more rapidly and flower more abundantly than the same species on the mainland.

Professor Verrill showed a number of drawings of marine invertebrates; painted in oil directly upon tiles and ground-glass tablets, they are helpful for purposes of museum illustration.

SAMUEL HENSHAW,
Secretary.

GEOLOGICAL SOCIETY OF WASHINGTON.

AT the 68th meeting held in Washington, D. C., November 24, 1897, Mr. M. R. Campbell made a brief informal communication on the Laminated Clays of Teay Valley, W. Va., and their origin and significance. The problem is but part of the broader problem of the physiography of that portion of West Virginia, which it is proposed by Mr. Campbell to consider on a future occasion.

Mr. J. S. Diller followed with a communication on 'The Origin of Camas Swale.' One of the principal tributaries of the Umpqua River in southwestern Oregon is the Calapooya. It rises upon the western slope of the Cascade Range, and near the eastern escarpment of the Coast Range enters the Umpqua River, which, in a remarkably meandering canyon, passes through the mountains to the Pacific. The general direction of the Calapooya is southwestward, parallel to the strike of the rocks, but nearly midway in its course it turns sharply to the northwest, and for four miles cuts directly across the general trend of the ridges and valleys. At this sharp turn heads a broad, shallow valley, known as Camas Swale. Its bottom is a plain stretching to the southwestward for about seven miles, with a width of from one to two miles. The swale is drained by Wilbur Creek, a small stream which enters the north fork of the Umpqua and for the greater part of its course is dry in summer. Camas Swale and much of the valley of Wilbur Creek, is larger than one would expect as the work of so small a stream, when compared with that accomplished by other streams of equal size in the same region.

The relation of Casmas Swale to the Calapooya suggests that it may once have been the bed of that stream. The principal flood-plain of the Calapooya is continuous with that extending through Camas Swale, and the pebbles of the bed of Wilbur Creek in the swale are largely volcanic rocks, such as could have been brought from the Cascade Range only by the Calapooya River. The size of the swale, too, bespeaks the action of a stream like the Calapooya, so that the evidence is quite clear that the Calapooya once flowed through Camas Swale, and by way of Wilbur Creek entered the north fork of the Umpqua.

Why did it change its course? The reason is to be found in the relation of Oldham Creek to the original course of the Calapooya. Along Camas Swale the two were originally parallel for a number of miles and separated by only a narrow ridge of sandstone. Oldham Creek reached the Umpqua by a direct course in six miles, while the water of the Calapooya, to reach the same point, had to travel twenty miles. Consequently, Oldham Creek, having the greater declivity, cut down its bed more rapidly than the Calapooya and enabled one of its side streams to cut through the dividing ridge and tap the Calapooya at the head of Camas Swale, thus diverting the waters of the Calapooya to their shorter course and leaving Camas Swale to be drained by Wilbur Creek, the beheaded portion of the ancient Calapooya.

W. F. MORSELL.

U. S. GEOLOGICAL SURVEY.

ENTOMOLOGICAL SOCIETY OF WASHINGTON, DECEMBER 2, 1897.

DR. F. C. KENYON, Washington, D. C.; Mrs. Annie Trumbull Slosson, New York city; Mr. R. J. Weith, Elkhart, Ind., were elected members. Officers for 1898 were elected as follows: President, Mr. H. G. Hubbard; Vice-Presidents, Dr. T. N. Gill and Dr. H. G. Dyar; Corresponding Secretary, Mr. Frank Benton; Recording Secretary, Dr. L. O. Howard; Treasurer, Mr. E. A. Schwarz.

Mr. Hubbard exhibited specimens in all stages of *Dinapate wrightii*, a very large and very rare Bostrichid beetle, the habits of which were not previously known, and which, in fact, was described from a fragmentary specimen only. Mr. Hubbard finds that this insect breeds in the trunks of *Washingtonia filifera* in southern California. He considers that the species is rapidly approaching extinction and calls it the Dodo of beetles.

Mr. Cook exhibited a new genus of Schizonotidæ, a family related to the whip-scorpions and at present containing two genera—*Schizonotus* and *Tripeltis*. The new form was discovered by Mr. Hubbard in Arizona and is distinct from others in containing two small

wedge-shaped sclerites in the transverse fissure of the cephalothorax. Mr. Cook dedicates the genus to Mr. Hubbard and the species may be called *Hubbardia pentapeltis.*

Mr. W. G. Johnson read a paper on Isaac P. P. Trimble, economic entomologist, giving an account of Mr. Trimble's life and exhibiting photographs taken at different ages and a large series of unpublished plates prepared under Mr. Trimble's direction for a second volume of his work on fruit insects. The plates excited considerable interest from their excellence.

Dr. Dyar presented a note on an external feeding hymenopterus parasite. This is a new species of the Ichneumonid genus *Pammicra*, which lays its eggs on a Nematine saw-fly larva, feeding upon black oak on Long Island. The parasite paralyzes the larva with its sting, lays two eggs upon its dorsum, and the parasitic larvæ feed externally, remaining in the larval condition five days.

Mr. Ashmead read portions of a systematic paper on the genera of the Eucharidæ and presented a new classification of the old family Chalcididæ, which he will make a super-family, Chalcidoidea, containing fourteen families.

L. O. Howard,
Recording Secretary.

TORREY BOTANICAL CLUB, OCTOBER 12, 1897.

No regular program had been prepared for this meeting, but notes detailing some results of summer's work were presented by Drs. Rusby and Underwood, Mr. Van Brunt, Mrs. E. G. Britton, Judge Brown, Mr. Eugene Smith, Mr. M. A. Howe and Miss Ingersoll.

Dr. H. H. Rusby spoke of his work at the Kew Herbarium in identifying some 2,000 plants of two Bolivian collections. As an indication of how the Columbia University has grown in the last few years, he noted that in working up a similar collection four years ago he was able to determine but 5 or 6 % by comparison with the plants in this herbarium, while of the present collection nearly 50 % were identified by this means. He added that the herbarium at Kew is also growing rapidly, and in four years has added to its collections nearly half as many specimens as are in the Columbia Herbarium. Dr. Underwood remarked that the Kew Herbarium is superior to the Paris Herbarium even in the plants of the French provinces. Of these, many are represented at Kew and not at all at Paris.

Mr. Cornelius Van Brunt spoke of his journey to the Selkirk and Rocky Mountains of British America, making many photographs of new or interesting plants.

President Brown described a precipice in the Shawangunk with an altitude of 2,200 feet, bearing pine trees on its summit only six inches high but with perfectly developed cones. Throughout the region *Arenaria Groenlandica* was abundant in bloom from June to September, most copiously in July. He remarked upon the abundance and profuse bloom of *Gentiana quinquefolia*, *Kalmia latifolia*, *Rhododendron maximum*, *Ilex montana* and the *Rhodora.*

Edward S. Burgess,
Secretary.

THE ACADEMY OF SCIENCE OF ST. LOUIS.

At the meeting of the Academy of Science of St. Louis on the 6th of December, 1897, fifty persons present, Mr. Julius Hurter exhibited specimens of a considerable number of reptiles and batrachians, mostly of Southern origin, which had been collected by him during the past season, and were additions to the known fauna of Missouri. Among the more interesting additions were the cotton-mouth moccasin, the banded water snake, Holbrook's water snake, the little brown snake, the Louisiana mud turtle, the chestnut-backed salamander (first detected west of the Mississippi River by Mr. Colton Russell), and the marbled salamander.

Mr. H. von Schrenk exhibited a series of specimens and drawings illustrating some of the injuries inflicted on the trees of St. Louis by the tornado of May, 1896, showing not only the formation of double twig elongation and growth rings, but the exfoliation of the bark and the consequent drying-out of fifty per cent. or more of the wood through the trunk and branches in several species.

One new member was elected, and one person was proposed for active membership.

William Trelease,
Recording Secretary.